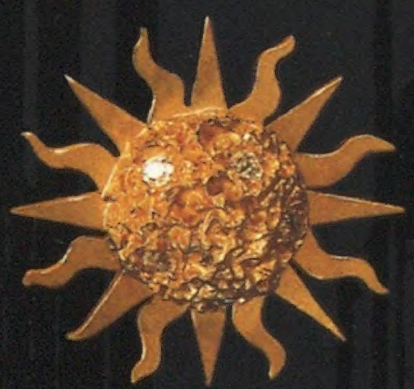
Smithsonian

May 1996



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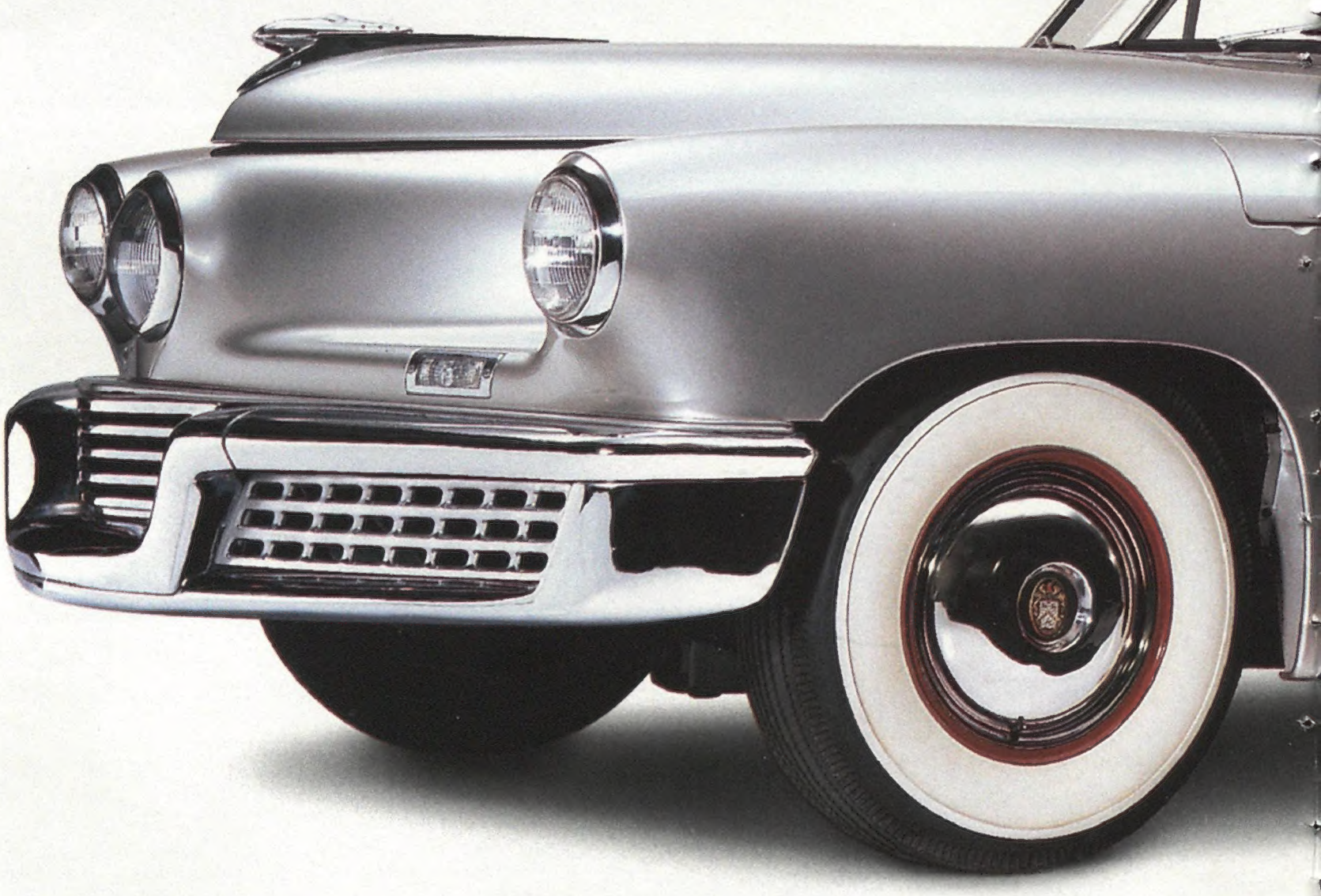

150 1846–1996 Smithsonian™

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The 1948 Tucker. One of only 49 in existence. Although the Tucker boasted futuristic styling engineering and design, it didn't attract many buyers. But it's been a major attraction from the day

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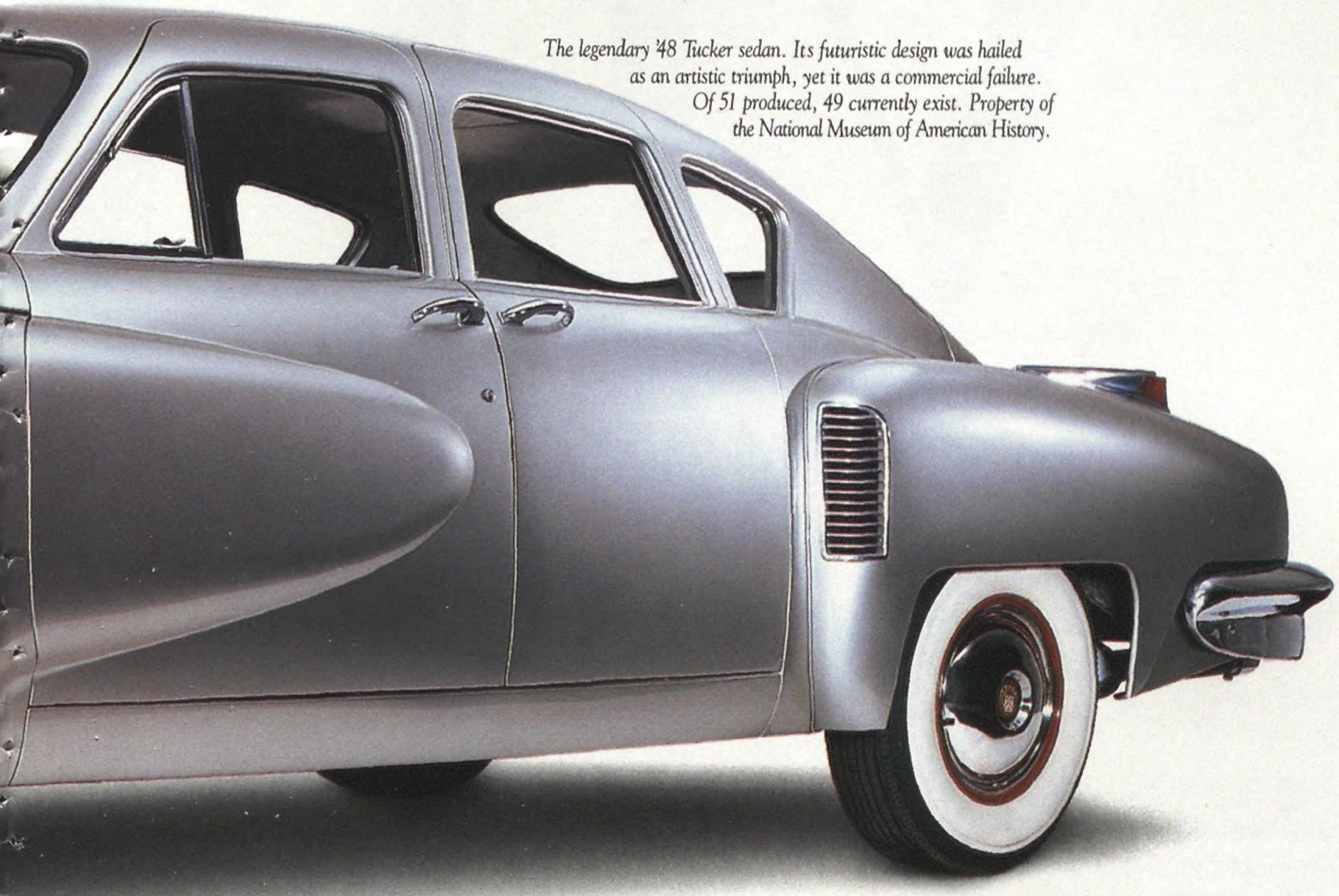

The legendary '48 Tucker sedan. Its futuristic design was hailed as an artistic triumph, yet it was a commercial failure. Of 51 produced, 49 currently exist. Property of the National Museum of American History.

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Smithsonian *features*

May 1996
Volume 27, Number 2

62

48

48 After 150 years, we're taking our show on the road
With "America's Smithsonian" the Institution brings the party to you—just wait 'til you see the presents
By John F. Ross, photographs by Kay Chernush

62 'When we stop singing, we will really be finished'
In the Brazilian jungle, anthropologist Tony Seeger tries to save a remote tribe's music, and its future
By David Roberts, photographs by Enrico Ferorelli

76 To build on the Mall, follow the Cardinal rules
An initial plan for the National Museum of the American Indian bears the stamp of a celebrated architect
By Jon Krakauer

82 Unlocking the mysteries of crime takes a skeleton key
Forensic anthropologists at Natural History use their knowledge of skulls and scapulas to help crack cases
By Elizabeth Royte, photographs by Robert C. Burke

94 For the Freer's scrolls, Japan is the place for TLC
Masters in restoring the fragile works, the Japanese are sharing their skills to preserve their art around the world
By Carol Simons

104 Mpala: a haven for man and beast in East Africa
To study ecology at the Smithsonian's new field site, scientists need only step outside and dodge the elephants
By Douglas Stewart, photographs by Art Wolfe

116 At the National Museum of American Art, a photo finish
When curator Merry Foresta went after a collection of early photography, she never guessed what would develop

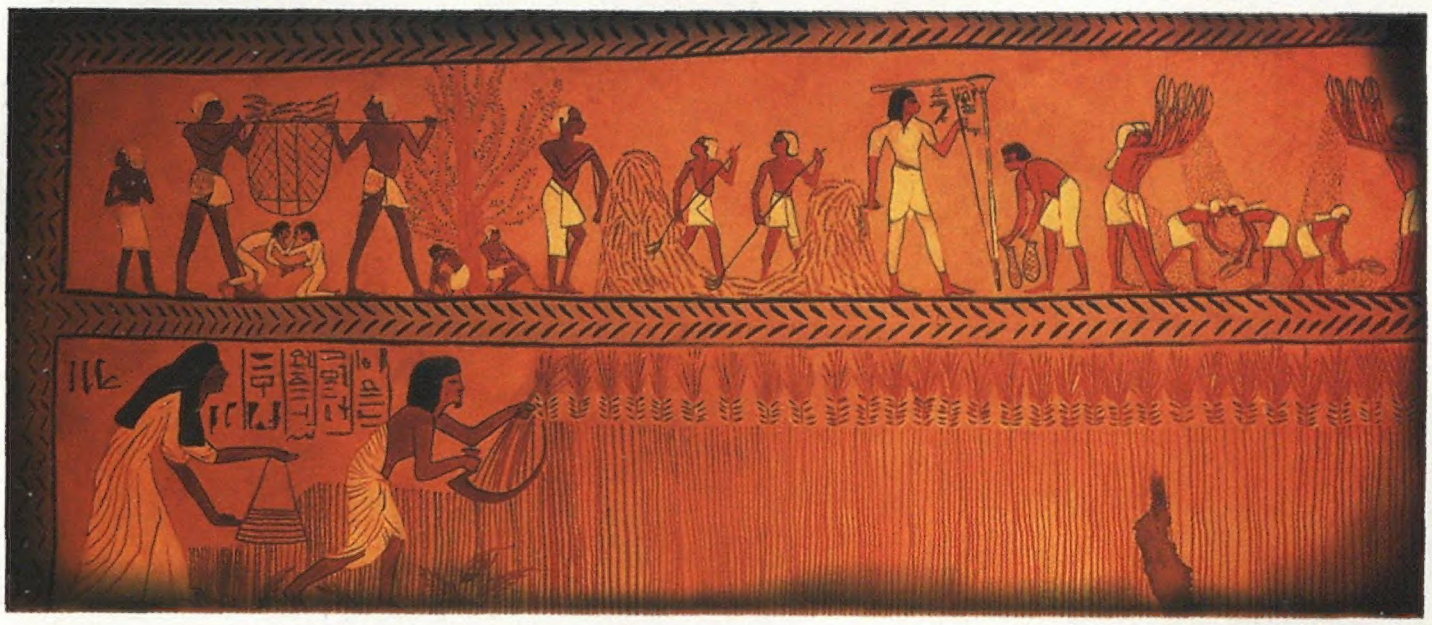
126 In search of the 'white ghost'—the giant squid
Using a submersible, a zoologist hopes to get a glimpse of a monster never seen before in its natural setting
By Richard Conniff

140 The new taxonomy: nothing like you learned in school
Had naturalists a century ago used today's system for classifying animals, gypsy moths might not be a problem
By Sue Hubbell

126

Continued on page 10

WHICH KIND OF INVESTOR ARE YOU?



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Smithsonian *departments*

May 1996
Volume 27, Number 2

Cover

Cover:
The sunburst of the Smithsonian mace, designed for the bicentennial of James Smithson's birth, is surrounded by images emblematic of the Institution's range and richness 150 years after its founding: (clockwise, from top left) detail from the "Bible quilt" (NMAH) made by a former slave; astronaut's helmet from Apollo 15 (NASM); detail from the quarter-scale model of the Montgolfier brothers balloon flown in 1783 (NASM); pocket watch (NMAH); Rosser Reeves star ruby (NMNH); *Beginning* by Kenneth Noland (HMSG); stained-glass dome of the grand hall (NPG); crowned crane (NZP)
Design by Shub, Dirksen, Yates & McAllister, Inc.

24 *Editor's Note*
26 *Letters to the Editor*
157 *Additional Sources*
158 *Smithsonian Study Tours and Seminars*
159 *Picture Credits*

22 Smithsonian Perspectives
Great museums and research centers depend on great directors, from Spencer Baird to Sylvia Williams
By Secretary Heyman

30 Around the Mall and Beyond
Caretakers of the weapons collection at American History, Harry Hunter and Sarah Rittgers are right on target
By Michael Kernan

34 The Object at Hand
Two gold sovereigns, part of James Smithson's original gift, are reminders of the Institution's unique start
By Edwards Park

41 Smithsonian Highlights: a calendar of events
44 *Highlights Continued:* From the woolly mammoth to the Teddy bear, a new book tells the story of the Smithsonian

152 Book Reviews Plus
Smithsonian publications, videos and recordings to order

160 These people belong in an institution!

30

160

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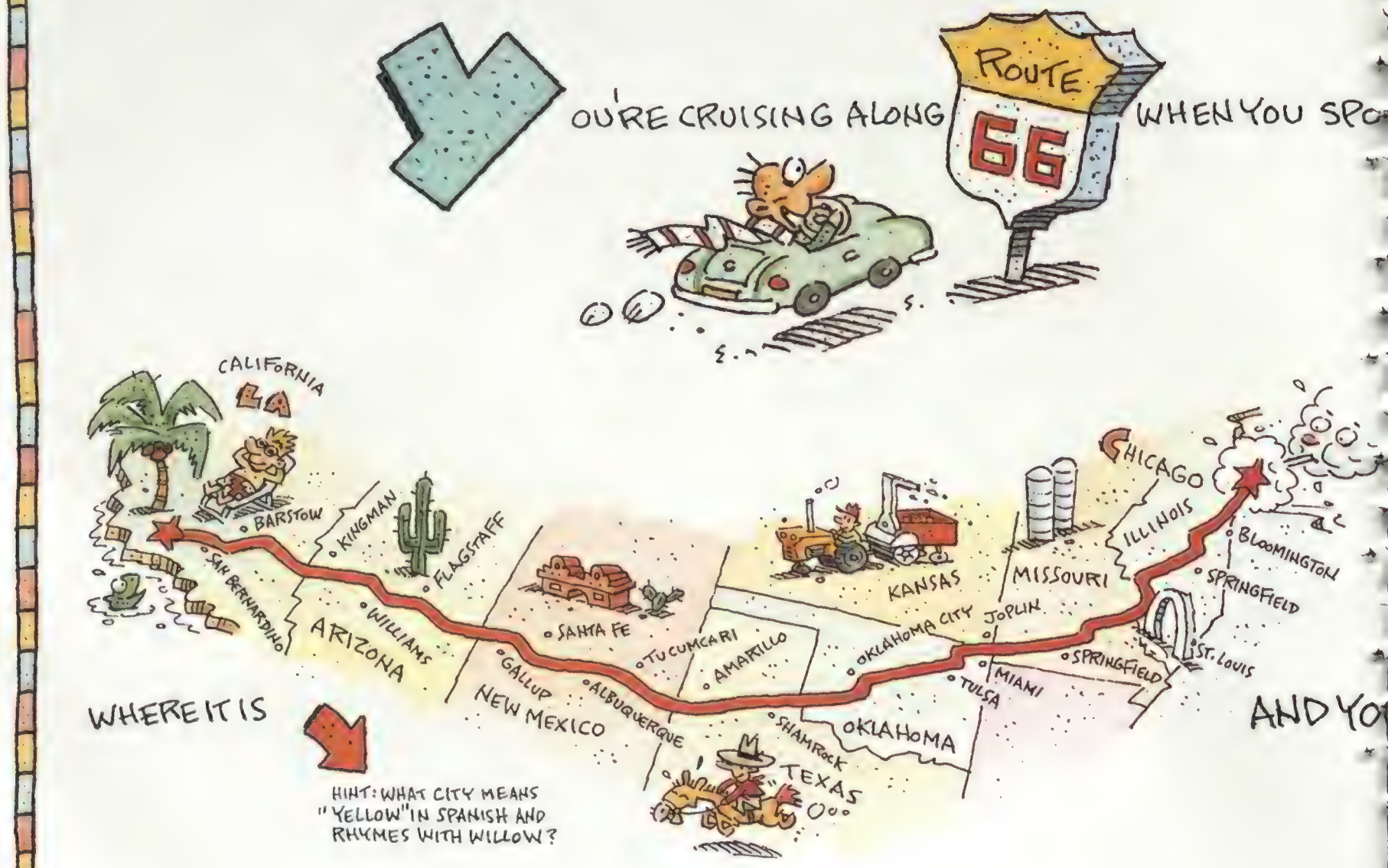

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Just identify which city or town along Route 66 the clues point to, write it on a postcard and send it in. Or call 1-800-637-4239 with your answer. Winners will be selected from all correct entries. (See complete rules below.)

MORE PRIZES. You could also win one of: 25 First Prizes of a Sony Discman, 50 Second Prizes of Sony Sports

OFFICIAL RULES. NO PURCHASE OR TRANSACTION NECESSARY. 1. HERE'S HOW TO PLAY: A) Identify the city in which the landmark is located as suggested by the game in this advertisement. B) On a 3" x 5" plain piece of paper, hand print your name, address (including zip code), daytime and evening phone numbers, and include your solution as to the city in which the landmark is located; C) send your entry in a business size (#10) envelope with First Class Postage **Affixed to: "ROUTE 66" Sweepstakes, P.O. Box 4443, Blair, NE 68009, or enter by calling 1 (800) 637-4239.** Only 3,500 calls will be accepted per month. All other callers will be instructed to enter by mail. Touch-tone phones only. Telephone lines open between 9 a.m. and 5 p.m. EST between March 5 and June 22, 1996. There will be three different games presented during the course of the sweepstakes. Enter as often as you wish, but each entry must be mailed separately; and D) to qualify for the Bonus Prize, you must also enclose an Official "ROUTE 66" Bonus Prize Certificate **only** (mechanically reproduced certificates are not eligible) with your entry available as per Rule #2 or see Rule #5B below. 2. If you wish to receive an Official Bonus Certificate and/or an official landmark city solution form, send a stamped, self-addressed, #10 envelope to: "ROUTE 66" Requests, P.O. Box 4454, Blair, NE 68009. Requests must be postmarked by 06/21/96 and received by 06/27/96. Limit one request per outer mailing envelope. Residents of WA **only** need not affix postage to return envelopes. 3. Entries must be received by 06/21/96 (or by 07/12/96 if Bonus Prize Certificate and/or the official landmark city solution form is included with entry). 4. RANDOM DRAWING: Winners will be selected in a random drawing on or about 07/19/96 from all eligible entries received by D.L. Blair, Inc., an independent judging organization whose decisions are final on all matters related to this program. To be eligible you must have provided a correct landmark city solution from any of the three games. Winners notified by mail. Odds of winning will depend upon the total number of eligible entries received. 5A. PRIZES AND APPROXIMATE RETAIL VALUE: (1) Grand Prize — a pre-owned 1957 Thunderbird with mileage (approx. retail value $40,000) or $40,000 in cash, (25) First Prizes

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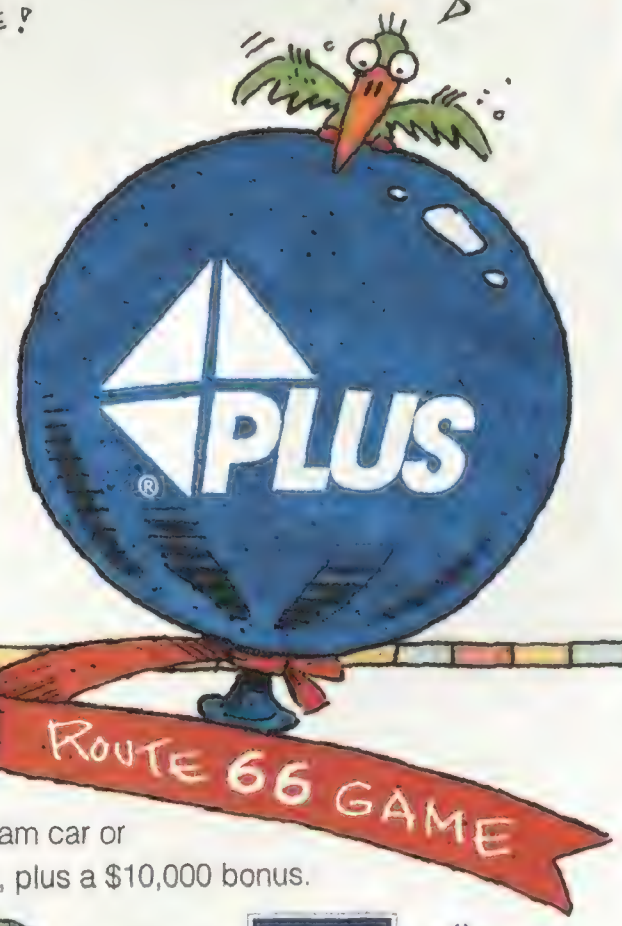

Walkmans, or 100 Third Prizes of canvas travel bags sporting the PLUS logo.

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Over 257,000 **in over 92 countries around the** **welcome** VISA PLUS

— a Sony Discman (approx. retail value $180 each); (50) Second Prizes — a Sony Sports Walkman (approx. retail value $120 each); (100) Third Prizes — a travel bag with Visa/PLUS logo (approx. retail value $40 each). 5B. BONUS PRIZE: A $10,000 Bonus Cash Prize will be awarded to the Grand Prize winner **only** if he/she can produce 3 PLUS ATM receipts from outside his/her home state dated between 03/07/96 and 06/21/96 inclusive **or** the Grand Prize winner has enclosed an Official PLUS ATM "ROUTE 66" Bonus Certificate with his/her entry (see Rule #1). 6. GENERAL RULES: Open only to U.S. residents who, as of 06/21/96, are 18 years or older. Employees of Visa, PLUS System, their affiliates, subsidiaries, advertising and promotion agencies and the immediate family members and/or those living in the same household of each are not eligible. Void where prohibited by law. Winner may make no substitution or transfer of prize. All federal, state and local taxes, insurance, licensing, registration and title fees are the sole responsibility of the winner. All federal, state and local laws and regulations apply. Potential winners must execute any required Affidavit of Eligibility/Release of Liability/Prize Acceptance Form within 15 days of attempted notification. Noncompliance within this time period may result in disqualification and an alternate may be selected. Return of any prize notification as undeliverable will result in disqualification and an alternate will be selected. Sponsor reserves the right to substitute prize of equal or greater value. Limit one prize per household (with exception of Bonus Prize). Acceptance of prize constitutes permission to the sponsor and its agencies to use winner's name and/or likeness for purposes of advertising and trade without further compensation, unless prohibited by law. No mechanically reproduced entries permitted. Not responsible for lost, late, postage due, illegible, damaged or misdirected mail/entries or faulty or incomplete telephone transmissions. By participating in this promotion, entrants agree to be bound by the Official Rules and the decisions of the judges. 7. For the names of the winners, available after 09/16/96, send a separate, stamped, self-addressed (#10) envelope to: "ROUTE 66" Winners, P.O. Box 4461, Blair, NE 68009.

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Feel like yourself again.
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Well accepted. As with all medications, side effects may occur. Always talk to your healthcare provider about any medication you may take. However, when Zyrtec was studied, most side effects were mild to moderate and included dry mouth and fatigue. The most common side effect was drowsiness (14% versus 6% on placebo). Only one out of one-hundred patients stopped taking Zyrtec due to drowsiness.

Zyrtec™
(cetirizine HCl) tablets

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Feel like yourself again.

Please see following page for information about Zyrtec 5mg and 10mg tablets.

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[1] Total sales from 92 countries during January 1988-October 1995

For Allergic Rhinitis and Chronic Idiopathic Urticaria

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Zyrtec™

(cetirizine HCl) tablets

Brief Summary
ZYRTEC™ (cetirizine hydrochloride) Tablets For Oral Use (FOR FULL PRESCRIBING INFORMATION, CONSULT PACKAGE INSERT) **CONTRAINDICATIONS** ZYRTEC is contraindicated in those patients with a known hypersensitivity to it or any of its ingredients or hydroxyzine. **PRECAUTIONS** Activities Requiring Mental Alertness: In clinical trials, the occurrence of somnolence has been reported in some patients taking ZYRTEC; due caution should therefore be exercised when driving a car or operating potentially dangerous machinery. Concurrent use of ZYRTEC with alcohol or other CNS depressants should be avoided because additional reductions in alertness and additional impairment of CNS performance may occur. **Drug-drug interactions:** No clinically significant drug interactions have been found with theophylline at a low dose, azithromycin, pseudoephedrine, ketoconazole, or erythromycin. There was a small decrease in the clearance of cetirizine caused by a 400 mg dose of theophylline; it is possible that larger theophylline doses could have a greater effect. **Carcinogenesis, Mutagenesis and Impairment of Fertility:** No evidence of carcinogenicity was observed in a 2-year carcinogenicity study in rats at dietary doses up to 20 mg/kg/day (15 times the maximum recommended human dose on a mg/m^2/day basis). An increased incidence of benign liver tumors was found in a 2-year carcinogenicity study in male mice at a dietary dose of 16 mg/kg/day (6 times the maximum recommended human dose on a mg/m^2/day basis). The clinical significance of these findings during long-term use of ZYRTEC is not known. Cetirizine was not mutagenic in the Ames test, and not clastogenic in the human lymphocyte assay, the mouse lymphoma assay, and the *in vivo* micronucleus test in rats. No impairment of fertility was found in a fertility and general reproductive performance study in mice at a dose of 64 mg/kg/day (26 times the maximum recommended human dose on a mg/m^2/day basis). **Pregnancy Category B:** Cetirizine was not teratogenic in mice, rats and rabbits at doses up to 96, 225, and 135 mg/kg/day (or 40, 180, and 216 times the maximum recommended human dose on a mg/m^2/day basis), respectively. There are no adequate and well-controlled studies in pregnant women. Because animal studies are not always predictive of human response, ZYRTEC should be used in pregnancy only if clearly needed. **Nursing Mothers:** Retarded pup weight gain was found in mice during lactation when dams were given cetirizine at 96 mg/kg/day (40 times the maximum recommended human dose on a mg/m^2/day basis). Studies in beagle dogs indicate that approximately 3% of the dose is excreted in milk. Cetirizine has been reported to be excreted in human breast milk; use of ZYRTEC in nursing mothers is not recommended. **Geriatric Use:** In placebo-controlled trials, 186 patients age 65 to 94 years received doses of 5 to 20 mg of ZYRTEC per day. Adverse events were similar in this group to patients under age 65. Subset analysis of efficacy in this group was not done. **Pediatric Use:** Safety and effectiveness in children under 12 years of age has not been established. **ADVERSE REACTIONS** Controlled and uncontrolled clinical trials conducted in the United States and Canada included more than 6000 patients, with more than 3900 receiving ZYRTEC at doses of 5 to 20 mg per day. The duration of treatment ranged from 1 week to 6 months, with a mean exposure of 30 days. Most adverse reactions reported during therapy with ZYRTEC were mild or moderate. In placebo-controlled trials, the incidence of discontinuations due to adverse reactions in patients receiving ZYRTEC 5 mg or 10 mg was not significantly different from placebo (2.9% vs. 2.4%, respectively).The most common adverse reaction that occurred more frequently on cetirizine than placebo was somnolence. The incidence of somnolence associated with ZYRTEC was dose related, 6% in placebo, 11% at 5 mg and 14% at 10 mg. Discontinuations due to somnolence for ZYRTEC were uncommon (1.0% on ZYRTEC vs. 0.6% on placebo). Fatigue and dry mouth also appeared to be treatment-related adverse reactions. There were no differences by age, race, gender or by body weight with regard to the incidence of adverse reactions.Table 1 lists adverse experiences which were reported for ZYRTEC 5 and 10 mg in controlled clinical trials in the United States and that were more common with ZYRTEC than placebo.

Table 1. Adverse Experiences Reported in Placebo-Controlled United States ZYRTEC Trials (Maximum Dose of 10 mg) at Rates of 2% or Greater (Percent Incidence)

Adverse Experience	ZYRTEC (N=2034)	Placebo (N=1612)
Somnolence	13.7	6.3
Fatigue	5.9	2.6
Dry Mouth	5.0	2.3
Pharyngitis	2.0	1.9
Dizziness	2.0	1.2

Due caution should be exercised when driving a car or operating potentially dangerous machinery.

In addition, headache and nausea occurred in more than 2% of the patients, but were more common in placebo patients. The following events were observed infrequently (less than 2%), in 3982 patients who received ZYRTEC in U.S. trials, including an open study of six months duration; a causal relationship with ZYRTEC administration has not been established. **Autonomic Nervous System:** anorexia, urinary retention, flushing, increased salivation. **Cardiovascular:** palpitation, tachycardia, hypertension, cardiac failure. **Central and Peripheral Nervous Systems:** paresthesia, confusion, hyperkinesia, hypertonia, migraine, tremor, vertigo, leg cramps, ataxia, dysphonia, abnormal coordination, hyperesthesia, hypoesthesia, myelitis, paralysis, ptosis, twitching, visual field defect. **Gastrointestinal:** increased appetite, dyspepsia, abdominal pain, diarrhea, flatulence, constipation, vomiting, ulcerative stomatitis, aggravated tooth caries, stomatitis, tongue discoloration, tongue edema, gastritis, rectal hemorrhage, hemorrhoids, melena, abnormal hepatic function. **Genitourinary:** polyuria, urinary tract infection, cystitis, dysuria, hematuria. **Hearing and Vestibular:** earache, tinnitus, deafness, ototoxicity. **Metabolic/Nutritional:** thirst, dehydration, diabetes mellitus. **Musculoskeletal:** myalgia, arthralgia, arthrosis, arthritis, muscle weakness. *Psychiatric:* insomnia, nervousness, depression, emotional lability, impaired concentration, anxiety, depersonalization, paroniria, abnormal thinking, agitation, amnesia, decreased libido, euphoria. **Respiratory System:** epistaxis, rhinitis, coughing, bronchospasm, dyspnea, upper respiratory tract infection, hyperventilation, sinusitis, increased sputum, bronchitis, pneumonia. **Reproductive:** dysmenorrhea, female breast pain, intermenstrual bleeding, leukorrhea, menorrhagia, vaginitis. **Reticuloendothelial:** lymphadenopathy. **Skin:** pruritus, rash, dry skin, urticaria, acne, dermatitis, erythematous rash, increased sweating, alopecia, angioedema, furunculosis, bullous eruption, eczema, hyperkeratosis, hypertrichosis, photosensitivity reaction, photosensitivity toxic reaction, maculopapular rash, seborrhea, purpura. **Special Senses:** taste perversion, taste loss, parosmia. **Vision:** blindness, loss of accommodation, eye pain, conjunctivitis, xerophthalmia, glaucoma, ocular hemorrhage. **Body as a Whole:** increased weight, back pain, malaise, fever, asthenia, generalized edema, periorbital edema, peripheral edema, rigors, leg edema, face edema, hot flashes, enlarged abdomen, nasal polyp. Occasional instances of transient, reversible hepatic transaminase elevations have occurred during cetirizine therapy. A single case of possible drug-induced hepatitis with significant transaminase elevation (500 to 1000 IU/L) and elevated bilirubin has been reported. In foreign marketing experience the following additional rare, but potential severe adverse events have been reported: hemolytic anemia, thrombocytopenia, orofacial dyskinesia, severe hypotension, anaphylaxis, hepatitis, glomerulonephritis, stillbirth, and cholestasis. **DRUG ABUSE AND DEPENDENCE** There is no information to indicate that abuse or dependency occurs with ZYRTEC. **OVERDOSAGE** Overdosage has been reported with ZYRTEC. In one patient who took 150 mg of ZYRTEC, the patient was somnolent but did not display any other clinical signs or abnormal blood chemistry or hematology results. Should overdose occur, treatment should be symptomatic or supportive, taking into account any concomitantly ingested medications. There is no known specific antidote to ZYRTEC. ZYRTEC is not effectively removed by dialysis, and dialysis will be ineffective unless a dialyzable agent has been concomitantly ingested. The minimal lethal oral dose in rodents is approximately 100 times the maximum recommended clinical dose on a mg/m^2 basis and the liver is the target organ of toxicity. **DOSAGE AND ADMINISTRATION** The recommended initial dose of ZYRTEC is 5 or 10 mg per day in adults and children 12 years and older, depending on symptom severity. Most patients in clinical trials started at 10 mg. ZYRTEC is given as a single daily dose, with or without food. The time of administration may be varied to suit individual patient needs. In patients with decreased renal function (creatinine clearance 11-31 mL/min), patients on hemodialysis (creatinine clearance less than 7 mL/min), and in hepatically impaired patients, a dose of 5 mg once daily is recommended. Cetirizine is licensed from UCB Pharma, Inc.

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Smithsonian

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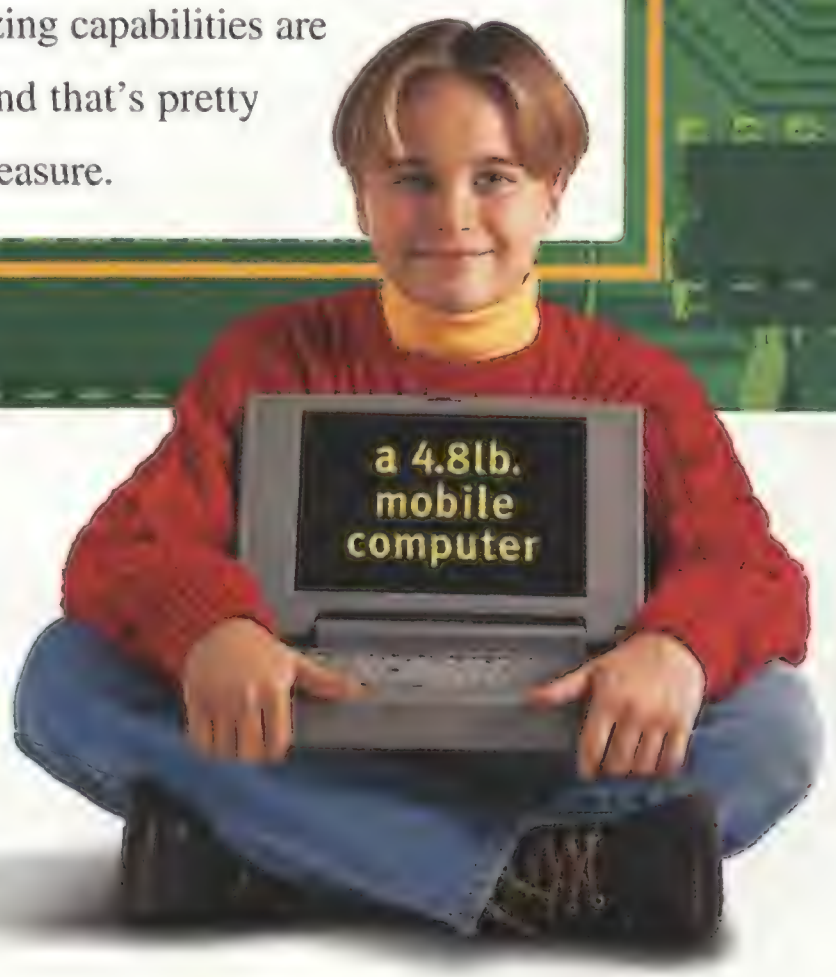

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Secretary Heyman's comments

Smithsonian Perspectives

Among the Smithsonian's greatest legacies has been its long line of directors with vision and drive

For those of us who have the privilege of working at the Smithsonian, our 150th-anniversary year has been a season of many pleasures. Chief among these has been the opportunity to send out across the nation in our "America's Smithsonian" exhibition some of the greatest of treasures we hold in trust for the American people.

The organizing of that Smithsonian-wide exhibition coincided with my first year at the Institution and served as a kind of crash course for me. Because the entire Smithsonian was to be involved, I needed to learn quickly how the individual museums fulfilled their responsibilities to the collections under their care.

What impressed me from the first was the passion the directors of the Smithsonian museums brought to their task. Each of them an expert in a different field and charged with a different mission, they were required to be pragmatists and visionaries at the same time, able to run a tight ship but steer by the stars.

I think of this now because we have recently lost a colleague and friend who stood among the finest of Smithsonian directors, Sylvia Williams of the National Museum of African Art. Her sudden death shocked us into an awareness of how central a figure she had become here and how much we had counted on her not only to lead her museum but also to set a standard for the balancing act we ask all our directors to manage.

Sylvia Williams might have remained a great curator, honing her scholarship at the Brooklyn Museum, but in 1983 she took on the task of guiding the relocation of a once-private museum launched by its founding director, Warren Robbins, to its present site on the National Mall. There she built with her staff a preeminent collection and exhibition program of world renown. She was a *feisty* director whose strength of character infused her museum and brought it to greatness.

So much of what the Smithsonian has become in its 150-year history is the result of the strength of its finest directors of museums and research centers. And yet it is amazing how often they are overlooked in the telling of that history, crowded out by the great donors and the parade of Secretaries.

If the directors of the Smithsonian have a patron saint, it would have to be Spencer Baird, who, in his years as director of the National Museum, made the Smithsonian's collections as fundamental to its purpose as was pure research. It was Baird who found ways to collect despite the hesitations of the then Secretary, Joseph Henry. Among his remarkable strategies was the acquisition of some 42 freight cars' worth of exhibits from the 1876 Centennial Exhibition. To house this material, Baird was able to acquire the land and appropriation for the National Museum building, today called Arts and Industries.

In the first half of the 20th century, another of the remarkable Smithsonian builders, Paul Garber, showed how a Smithsonian museum could be virtually willed into existence. Garber launched his 72-year association with the Smithsonian in 1920 as "preparator" of exhibits at the National Museum, then went on to become the first head of Aeronautics. In 1946 his pleas to Senator Jennings Randolph led to the creation of the National Air Museum, and the ultimate creation of facilities to house the scores of aircraft he had collected. Never called a director, he was one in the fundamental sense of having shaped the direction of his museum.

Some of the greatest of our directors arrived not at the birth of an organization but when it was languishing. The Smithsonian Astrophysical Observatory (SAO) was all but moribund when Fred Whipple was asked to take it over in 1955. He oversaw its relocation to Cambridge, Massachusetts, and soon gained it world recognition as a tracking network for the new age of satellites, beginning with Sputnik. Whipple later set about getting the SAO its first major ground-based observatory, which was sited in southern Arizona and later renamed in his honor. He can be credited with setting the SAO on its course as a great astrophysical center.

Whipple's 18 years at the SAO were more than matched by Theodore Reed's 28 years at the National Zoo, another case of a director who coaxed a sleepy part of the Institution to new life. Reed was among the first of our directors to realize the power of citizens awakened to important needs. In 1956, he formed the Friends of the National Zoo (FONZ), which has become a bedrock of support. It was Reed who expanded the role of the zoo to vital research in veterinary science and the study of animal behavior.

I haven't the space here to tell you much about Frank Taylor, whose 20 years of advocacy led to the creation of the Museum of History and Technology, now the National Museum of American History; or of John Kinard, the minister turned director of the Anacostia Museum, who gave African-American culture a vital home at the Smithsonian; or of the legendary Joshua Taylor, whose stewardship of the National Collection of Fine Arts (now the National Museum of American Art) became a cornerstone of the Smithsonian's expanding commitment to the arts.

These and other great directors in the Smithsonian's history have managed the toughest of balancing acts. Each of them infused their organizations with their drive and spirit. In their day it was often said that their organizations were unimaginable without them. And yet they left as their legacies museums and research centers that were strong enough not only to survive but to advance to ever-higher levels of achievement.

I. Michael Heyman

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150 candles for the Smithsonian, and a jungle river clear as glass

Photographer Enrico Ferorelli with his new friend Robndo, a Suyá elder.

In the event that you've been living on Saturn for the past few months, you might not be aware that the Smithsonian Institution is in the midst of a year-long birthday celebration—its 150th birthday, as a matter of fact. Activities include a twelve-city tour of treasures from the collections, the striking of a commemorative coin and a host of special programs (some of them are listed on p. 43), culminating in August with a birthday party on the Mall, to which everyone is invited.

The Smithsonian is most widely known, of course, as a repository for a mind-boggling conglomeration of stuff—exactly 138,843,570 pieces of it, at last count. All of that stuff—along, perhaps, with the fact that the Institution's headquarters, the grand old Castle, looks like a refugee from a Charles Addams cartoon—is what earned the Smithsonian its nickname "the nation's attic." (That phrase makes the Institution's scholars grit their teeth, but it's always used affectionately—one could do worse.)

But the attic image fails to suggest the amazing diversity of the Institution's interests and activities. At any given moment, Smithsonian scholars and scientists might be transcribing the complexities of Duke Ellington's "Take the 'A' Train," probing the structure of the Universe, analyzing the DNA of elephants or assiduously collecting objects of material culture—from Chuck Yeager's flight jacket to Archie Bunker's chair—that might help future generations to understand who we were.

In this issue—and in stories in other issues throughout the year—we will attempt to provide a picture of what goes on behind the scenes at this most unusual of institutions. For months our writers and photographers have been shadowing Smithsonian researchers in their laboratories, amid the collections and in the field, and naturally they brought back some war stories. Shooting the piece on Kenya's Mpala Ranch, photographer Art Wolfe was repeatedly ambushed by a choleric bull elephant that had taken up residence in the researchers' compound. "It's hard to be fast and elusive when you've got an 800-millimeter telephoto lens in tow," he reported. At sea with marine biologist Clyde Roper, writer Richard Conniff grew uneasy when their boat was overtaken by a violent thunderstorm. "Roper was unflappable. I asked mildly if the boat was equipped with lightning rods. He replied with a gleeful cackle—'*Heh, heh, heh!*'—which I took to mean no. I said a prayer." Arriving safely ashore, Conniff was soothed when Roper—who loves to eat squid as well as study them—passed on a couple of his favorite recipes for cephalopod cookery. (His secret: "If you can throw in more garlic, do it!")

Photographer Enrico Ferorelli, shooting a story on anthropologist Tony Seeger in the Brazilian jungle, had a kind of epiphany when the Suyá Indians guided him "up a dream river so transparent you could see the fish at the bottom" to a secret place of vital importance in their history. "No outsider had ever been here before, and I was struck by this demonstration of their trust and friendship.

"But maybe what is really memorable is that there is an institution that would support the work of Tony Seeger as he managed to gain the trust of those wonderful people, learn their language, their dances and rituals, and be allowed to participate in their life. I came to feel and understand our sameness, despite the differences of feather adornments and telephoto lenses. It was only because a bridge had been laid by an institution with a mission."

Don Moser

Letters to the Editor

In February we asked our readers to help us celebrate the Smithsonian Institution's 150th anniversary by sending us an anecdote about their first visit to the museums. Here are but a few of the hundreds of submissions we received.

I first visited the Smithsonian for one day in August 1976 with my nephew. We entered a small gallery in the Hirshhorn Museum and Sculpture Garden where I saw a seated man who appeared to have dozed off while reading a newspaper. I had just read an article about the sculptor Duane Hanson, who placed his lifelike creations of ordinary people, wearing real clothes and working wristwatches, in real-life settings. "People think the sculptures are alive and try to talk to them," I told my nephew. We stood admiring the dozing "man," commenting on the details we thought were especially realistic.

Ignoring my admonition not to touch the display, my nephew very carefully reached forward to move back the sculpture's coat sleeve to check the time. The dozer raised his head, mumbled something and offered us his newspaper. My nephew gasped, "He's alive!" before fleeing, leaving me to explain to the befuddled gentleman why two strangers were trying to read his watch.
Verna Louise Young
Fremont, Ohio

It must have been sometime in the late 1940s. We had moved to Washington after the war and ended up seeing most of the famous sites at the behest of visiting relatives. My parents, with two children under 10 in tow, approached the Smithsonian with trepidation. And with good reason. Almost as soon as we were through the door, I escaped and went exploring on my own.

At some point I happened into the technology section, which was just the thing for small boys. There I found several mechanical exhibits where, if you pushed a button, all sorts of intriguing things began to happen. The one I remember best was a cutaway of an elaborate coal mine where tiny steam shovels scooped, elevators descended and trains ran around underground, ferrying extracted coal. I stood before the glass window, peering into this mechanical world for probably half an hour, pushing the operative button over and over again. It was there that my frantic parents finally found me. My mother, now in her 80s, says she had told us to stay together, and insists my alibi was, "I thought you said, 'Once we're in the Smithsonian, everybody scatter.'"
Ken Ringle
Washington, D.C.

I am a fifth-generation, native-born Washingtonian, and my family and I attended the Kendall Baptist Church at Independence Avenue and 9th Street. As a preteenager in the 1930s, I spent Sunday service time exploring the Smithsonian (unbeknownst to my parents, who thought I was with a young people's church group), where I especially enjoyed the First Ladies' Inaugural gowns and the cars. I always managed to get back to the church just as the last hymn was being sung. In the picture below, I am in the back row at the far right.
Mary Frances Noone
Valrico, Florida

My husband and I were in Washington for our honeymoon and bought tickets to see the Imax film *The Dream is Alive* at the National Air and Space Museum's five-story Langley Theater. The film is about the history of the space shuttle program and is narrated by Walter Cronkite.

Inside the theater, a young woman sat facing the audience on a small platform beneath the screen. She used sign language to communicate with a boy in the front row, and we realized she was a museum employee who was there to interpret the film for him.

The theater darkened; the audience quieted. Almost imperceptibly at first and then growing louder, the sound of birds in the marshes around the Cape Canaveral and Kennedy Space Port blared in our ears. The interpreter made lovely fluttering movements with her hands. Next, we saw and heard the

Portuguese Blues.

The blues that adorn the white houses of Obidos, 50 miles from Lisbon, are typical examples of local color.
It's a feature beautiful enough to have been the inspiration behind a few songs and not all of them sad.
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rumbling of the shuttle launch, which we also felt in the pits of our stomachs. The interpreter simultaneously signed the countdown and her hands mirrored the spectacular lift-off.

Throughout the movie, we watched as the interpreter made the experience come alive for the boy in the first row. We will never forget the expressiveness of her motions.

Jan Siebold
East Aurora, New York

I first visited the Smithsonian on my honeymoon in June 1927. I was walking up the grand stairway to the Castle when a dog came running toward me. A guard shouted for me to "stop that dog," which I tried to do with my new Bostonian shoe, but the dog bit through it. That made me angry, so I grabbed for the back of his neck but missed, and he bit me on the hand. The "powers that be" inside the Castle had a limousine take me to a doctor's office where my wound was dressed.

When I returned home, a letter containing legal papers awaited me that said I must return to Washington for the Pasteur treatment since no one could find the dog. I signed the papers, absolving anyone of any liability.

Congratulations on your 150th. My wife and I will be celebrating our 69th.

Edward G. Arrowsmith
Vancouver, Washington

Coco visited the Smithsonian only once by breaking the laws of man and risking death under the laws of nature.

Her crown as the world's most oblivious springer spaniel was mitigated only by the dubiously charming addiction she had to being my wife Bonnie's constant companion.

We thought we were safe one cool, spring evening after Bonnie shut Coco in our house and came running with me through Rock Creek Park, just down the hill from our house. Our path took us through the lower end of the National Zoological Park, a section then devoted to duck and geese ponds plus barred areas of a few, ah, serious animals. Our ambition for exercise faded and we retraced our steps. As soon as we passed the Zoo entry symbol meaning "pets strictly forbidden," we spotted Coco eagerly trotting toward us. She'd muzzled open our back porch screen door and tracked Bonnie with her selectively keen nose. As covertly as possible, we hurried back through the Zoo, urging Coco to become invisible. Since she had found Bonnie, Coco felt no other obligations and scampered ahead of us.

She rounded a bend, with me 30 feet behind her, and sniffed her way toward bars set in the shadows of a tree-covered bluff. She stopped to catch her breath and consider the sidewalk beneath her citified paws.

The evening exploded with a blur of silent muscled lightning, flashes of yellow and black, as two shapes lunged toward the limits of their world. Two jaguars were enticed by Coco, who dawdled so tantalizingly close to their touch. The jaguars reared up and pressed their bodies against the bars. Coco's fur was no more than two inches away from them.

We did the only thing we could think of: Bonnie jogged back toward our house. Coco took an eternity to figure out that *Hey, that lady is going away again*, then padded off, following her.

And I sympathetically watched the jaguars, those magnificent gold-and-black spotted hunters, stretch and ache for what could have been before they dropped their retracted claws and silently melted back into the darkness.

James Grady
Takoma Park, Maryland

I stared and stared and stared at the Hope Diamond at the National Museum of Natural History, searching the air around it for clues to its curse. It didn't look evil to me; it didn't even look that big. But I had been told it was the biggest blue diamond in the world, and I was enthralled. To a first-grader, "the biggest" means a lot, and curses are both spooky and intriguing.

I hadn't noticed I was missing, but my panicked elementary school teacher grabbed my arm and dragged me to join my classmates. "Can you spell 'geology'?" she asked. "Do you know what it means?" I can and I do, learning both after my introduction to the Hope 20 years ago.

Deborah K. Becker
Dodge Center, Minnesota

When my son invited me to meet him in Washington, D.C., it was all very wonderful, but the most memorable moment was while walking among the musical instruments in the National Museum of American History. I heard singing and turned toward the sound. A man and a woman were standing by an old Victrola, listening to the music. I asked them, "Is that Caruso?" They said yes. The couple seemed so happy when I explained I'd once had a phonograph just like that and a record of Caruso singing that particular piece. I was delighted hearing and recognizing that glorious voice after 50 years.

Dorothy E. Jacob
Salt Lake City, Utah

My parents encouraged my two brothers and me to learn about nature firsthand. We had a "museum" in an old bookcase where we exhibited interesting things we'd found in our backyard and the surrounding woods of Oxon Hill, Maryland. An exhibit I particularly remember was a praying mantis egg sac. One day it hatched, and we were chasing miniature mantises all over the house, much to our mother's distress.

When I was about 10, we captured an unusual beast (for us), and our mother took us to what is now the National Museum of Natural History where the curator of reptiles, Doris Mabel Cochran, identified our animal as a skink, a type of lizard. Miss Cochran allowed us to see and touch some of her live specimens, and later we went with her and some of her colleagues on collecting expeditions at the Kenilworth Aquatic Gardens.

Charles F. Janes
Gloucester, Virginia

My boyhood hero was Charles A. Lindbergh. In grammar school I read everything about him I could find, including his autobiography *We* (he thought of himself and his plane as one).

In 1951, while in the service, I went to the Arts and Industries Building. The *Spirit of St. Louis* hung from the ceiling, as if poised to land. Its wingspan was less than the width of my high school classroom. Its wheels buckled inward, and the silver cloth "skin" resembled a speckled trout. What a simple yet magnificent machine.

Joseph P. Rumage
New Orleans, Louisiana

The best part of being at the National Air and Space Museum was finding the small piece of moon rock that is there for all of us to touch. To me this represents only the beginning of what the possibilities are, what our dreams are made of. If we dream, we have potential, and anything is possible.

Kathryn A.B. Barnum
Midland, Michigan

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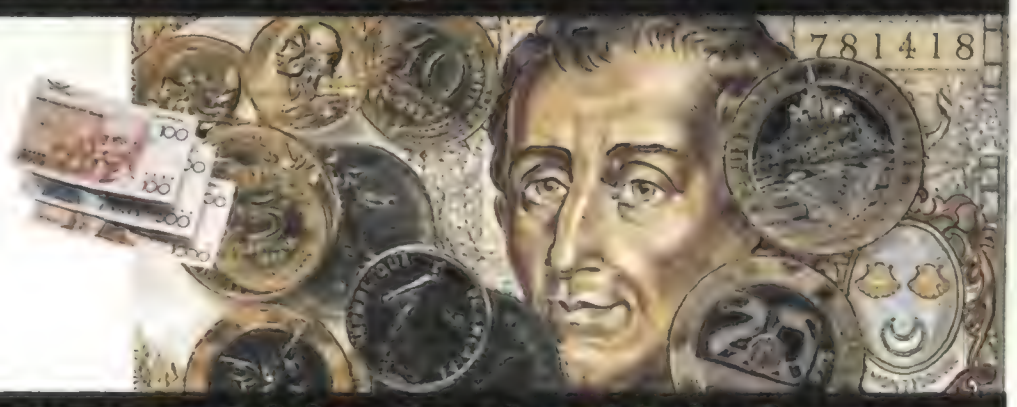

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Around the Mall and Beyond

By Michael Kernan

When they aren't overseeing a collection of 10,000 rifles, swords, harquebuses, crossbows and bazookas, Harry Hunter and Sarah Rittgers like to go out and hit a few bull's-eyes

"Harry taught me everything I know about the evolution of weapons," says doctoral student Rittgers, also a target shooter. With fatherly pride, Sergeant Hunter, USA (ret.), shows off her winning target from a national shoot-out.

"Our parents never allowed us to have guns," recalls Sarah Rittgers. "There were four girls and one boy, and when we couldn't get guns we would make our own out of sticks. But we weren't even allowed to do that. We couldn't even point a stick at someone. And they wouldn't let us watch Westerns because they felt they were too violent."

Nevertheless, last summer Rittgers took first prize in a national shoot-out with a muzzle-loading rifle. She scored 94 with two x's (which means right on the bull's-eye) in the National Muzzle Loading Rifle Association (NMLRA) match at Friendship, Indiana. That's at 200 yards. In a 25-mile-an-hour wind.

Harry Hunter, her boss and a 31-year veteran in the military history division of the National Museum of American History, keeps her target on hand to show visitors. "You can see, the shots are bunched a little to the left," he says with fatherly pride. "She overcompensated a bit for the wind. Otherwise she would have had 'em right on the x."

Rittgers is soft-spoken and comes across like a scholar who'd want nothing to do with powder burns and the kick of a rifle. She "kind of fell into" this career of hers as an expert in muzzle-loaders. "I was always interested in history, and I got a job at the museum as a summer intern; then I was a secretary in military history about five years. But I would get in early, and Harry would let me come back here and work with him about an hour before 9 o'clock."

Hunter and the place where they work are themselves a story. An Army career man who served mostly in the Pacific in World War II, he retired as a first sergeant. He's gruff and quick to laugh at a visitor's misinformation—but then as hospitable as can be in showing off the collections. Protected by an elaborate security system in an off-limits area at American History, Hunter and Rittgers spend their days in a room stacked to the ceiling with 10,000 muskets, pistols, swords, crossbows, harquebuses and other matchlocks, double-barreled shotguns, Kentucky squirrel rifles and other terrible machines dating from the 16th century on up to the 20th century's M16 and Uzi.

The oldest is a hand cannon that was forged around 1550. There are other antiques with barrels as big as stovepipes, things you carry on a cart or stand on a tripod. There are killer-bazookas and a death-dealing Philippine creation with a fur lock cover. There are little tinny breech-loading shotguns the size of my first popgun, the one with the cork on a string. There is Sam Houston's repeater rifle, with a harmonica-like bullet holder at the breech and his name beautifully inscribed just above it.

The big stuff—the machine guns, including Gatlings, and other monsters—is kept in separate storerooms.

I see Sharps and Spencer repeaters and, of course, numerous Winchesters. Some of the rifles are decorated with brass studs, a trademark of Indian gun

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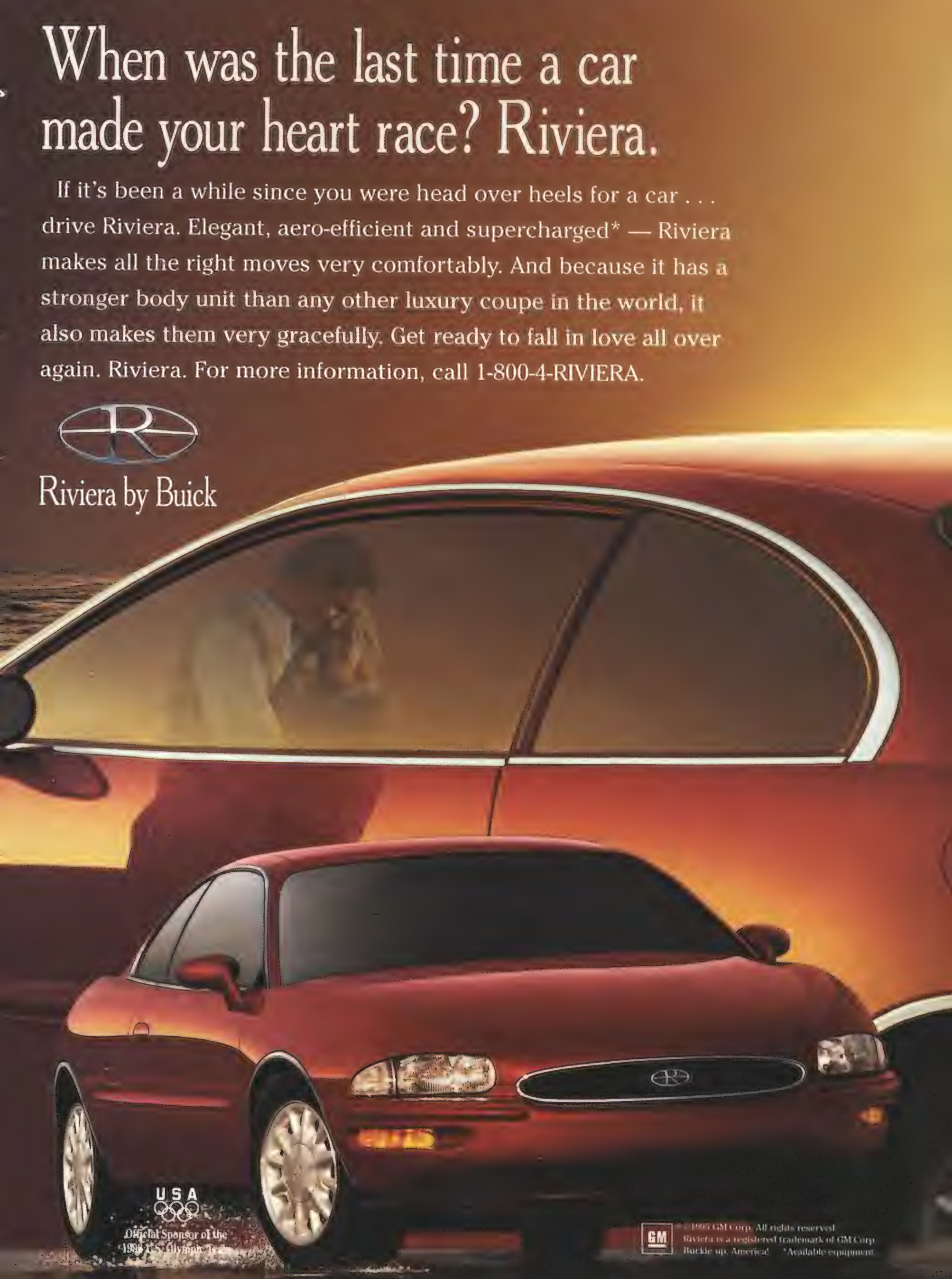

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owners. The stock of one Winchester is carved with the name and face of one Lieut. William Mitchell. In 1901, while in Alaska with the U.S. Army Signal Corps, the young lieutenant got lost. Afraid that he would freeze to death, he decided to memorialize himself on the gun. But rescuers reached him in time, and he went on to become the "Billy" Mitchell of air force fame.

And swords, 2,000 of them: drawer after drawer of gold-and-silver-hilted presentation swords, including Union general Phil Sheridan's pearl-studded one and the sword that Strong Vincent, then a Union colonel, carried at Gettysburg. Vincent was mortally wounded in that desperate struggle, July 2, 1863, and died five days later. His widow gave the weapon to the museum. The commands that he held during the Civil War are engraved on the sword's scabbard.

I was given some white gloves so I could handle George Washington's personal battle sword, with its green ivory handle and silver braid. "American steel," Hunter mutters. "Mostly iron. Don't drop it, now." For the next two years the sword will be touring as part of "America's Smithsonian" (p. 48).

Then I ask Hunter about the Garand rifle, which, as I remembered, was supposed to be notoriously temperamental. "Not at all," he scolded. "It worked very well. I carried one for the better part of 20 years."

But I want to get back to rifles like the one Rittgers shot. I heft one: ten pounds of steel and wood, and almost five feet long, it couldn't have been much fun to tote on a 20-mile march through the tangled brush of Chadds Ford or the prickly pine forests of Oriskany during the Revolutionary War.

"This is a flintlock," Rittgers points out, "which means that when you pull the trigger this little piece of flint scratches out a spark and ignites the powder in the flashpan, which flashes through the touchhole in the barrel and sets off the main charge."

She shows me how you pour the powder into the muzzle and ram home the bullet, lay a bit of extra powder in the flashpan and clamp down the frizzen (the top of the flashpan) and cock the trigger mechanism. A matchlock is similar, except that instead of a flint to create a spark, you have a rather woebegone-looking piece of match cord dangling near the touchhole, and this must be lighted. With luck, it will smolder all through the battle. Pulling the trigger brings the glowing end up to the flashpan and sets it off.

I had read that in the Revolutionary War and, especially, in the Civil War, soldiers didn't bother to tamp down the bullet with the ramrod but simply pounded the gun's butt on a rock. "Any soldier who did that should have been shot," commands Hunter. "That's not taking good care of a gun." And, of course, it doesn't work with a rifle, Rittgers gently informs me. Even with the ramrod, it's hard enough to force the bullet down a rifled barrel.

The rifling of gun barrels (cutting curved grooves inside the barrel that cause the bullet to spin and therefore fly straighter) started in the early 16th century, and it did a lot for accuracy. "The evolution of the gun didn't happen overnight," Hunter explains, "but it replaced the bow and arrow soon enough. An army would have a company of sharpshooters with rifles. Didn't need a lot of 'em. Put a hole in those bowmen right quick."

I see a case of Civil War cartridges, too. Unlike today's metal cartridges, they were merely little paper packages, each containing one charge of powder and a ball.

It was American history that got Rittgers started. Back home in Allendale, Michigan, her father often took the family to museums and battlefields, which naturally led her to major in history. She went on to get her master's at George Washington University and is continuing on there toward a doctorate in U.S. military history.

"When I read about muzzle-loaders in the Civil War, I wondered what it was like to shoot one. I'd never fired anything before, except maybe a BB gun. Then Harry went out to the NMLRA shoot in Indiana and came back all excited. 'You have to go,' he said. So last year Harry and I went out there." The association holds two major matches a year; they include events ranging from skeet shooting contests to target shooting—with ranges up to 500 yards—to tomahawk throws. The safety procedures, Hunter notes, are "very, very good, better than in the military."

In Rittgers' specialty, involving rifles of about .58 caliber, the shooters have 45 minutes to make the ten shots. Some contestants go for authenticity, dressing in buckskins and living in tepees, even using powder horns. But Rittgers and Hunter use modern metal powder measurers to pour their charges.

Well, I suggest, shooting muzzle-loaders must be a pretty exotic sport. Not at all, explains Rittgers. "The NMLRA has 24,000 members. It's really a lot of fun. But it takes patience. You have to learn how to sight and how to shoot from various positions. We go to ranges out in Virginia to practice."

The best Hunter could do last time was third place. "It's kind of hard with my bifocals," he shrugs. "You can see the target or you can see the gunsight, but you can't see 'em both at once." I know exactly what he means.

"A year ago," Rittgers says slowly, as though a little surprised at herself, "my husband and I bought our first gun for self-protection. It was the first time I'd ever been in a house with a gun."

She's surrounded by guns at the office. She takes me back to the corner where she and Hunter recondition old guns and repair recent acquisitions. A half-completed muzzle-loader lies on the workbench, its silvery octagonal barrel fresh from the mold. It's not often you see a brand-new muzzle-loading rifle. She's building it from a kit.

"I'm sort of an apprentice," says Rittgers. "Harry's taught me everything I know about the evolution of weapons and what came when. We spend a lot of time answering inquiries from all over the world, by letter, phone and computer. People say they have an old gun and want to know what it is. Then there's all the paperwork involved in accessioning a new item. And inventory: we're starting an inventory and computerizing all our holdings. That'll take some time. And, of course, if there's anything that needs cleaning or fixing, we do that."

It's not the whole story, however. There's all that lore. Like the gun that shoots around corners. The Germans were experimenting with one in World War II for street fighting, and the Americans were, too. "It wasn't bent like you think," Hunter chuckles. "More like a very slight curve. But it never turned into anything. It just didn't work."

I ask if they have any famous outlaws' pistols, and remark that it would be nice to have the Colt .32—whittled from wood and painted with black shoe polish—that John Dillinger used to escape from jail in March 1934. But no such luck; it's at the John Dillinger Museum in Nashville, Indiana. Besides, would that be a weapon? An interesting question.

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it all stays that way.

for our kids. It just feels good to be working for a company that's doing something about it."

Mason Lilley, Forester

Georgia-Pacific

The Forest Products Company

The Object at Hand

By Edwards Park

All but two of 104,960 sovereigns from a learned Englishman with no birthright were reminted here to fund the kind of institution he had in mind

Their value isn't intrinsic: after all, they are merely two British gold sovereigns, with Queen Victoria as a teenager on one side, the royal coat of arms on the other. About the size of a nickel, they were worth only a pound sterling each a century and a half ago when they were in circulation. But to the Smithsonian, which keeps them in its National Numismatic Collection (one is now traveling with the "America's Smithsonian" exhibition), they have a significance beyond any monetary value.

The story begins in 1826 with the writing of a will by an Englishman named James Smithson. Born in 1765 and educated at Oxford, Smithson studied chemistry and mineralogy and became a notable amateur scientist. He chemically analyzed minerals and plants, and was the first to distinguish between zinc carbonate and zinc silicate, both then called calamine. Since 1832, zinc carbonate has been known as smithsonite. In 1787, only a year out of college, he was elected to the Royal Society of London "for Improving Natural Knowledge."

Smithson was also a highborn bastard, and a man with ambitions as well as a large grievance. His father was a wealthy Yorkshire baronet who became the Duke of Northumberland. His mother was a descendant of Henry VII. Alas, because these two illustrious parents never got married—at least to each other—James Smithson had no chance of inheriting his father's title, fortune or dukedom. The fact continued to rankle. One of Smithson's lifelong aims became the spread of knowledge, which, he said, allows learned people to "see a lot where others see nothing." He wanted, he wrote, to ensure that the Smithson name would "live in the memory of man."

Eventually he inherited a good deal of money, mainly from his mother, and decided to leave it all to his illegitimate 20-year-old nephew—but with a remarkable stipulation attached. If the nephew died childless, the fortune would go toward "an Establishment for the increase & diffusion of knowledge among men." Not in England. Not at all. Smithson was not about to do that. The money was to go to the United States of America. The eventual result was the Smithsonian Institution. ("From Smithson to Smithsonian: The Birth of an Institution," a show organized by the Smithsonian Institution Libraries, tells the whole story. It opens July 2 and runs through the rest of the year at the National Museum of American History.)

James Smithson left a legacy to the United States. His gift, in British coins with Queen Victoria on one side, was melted down and then restruck, some as ten-dollar American gold eagles.

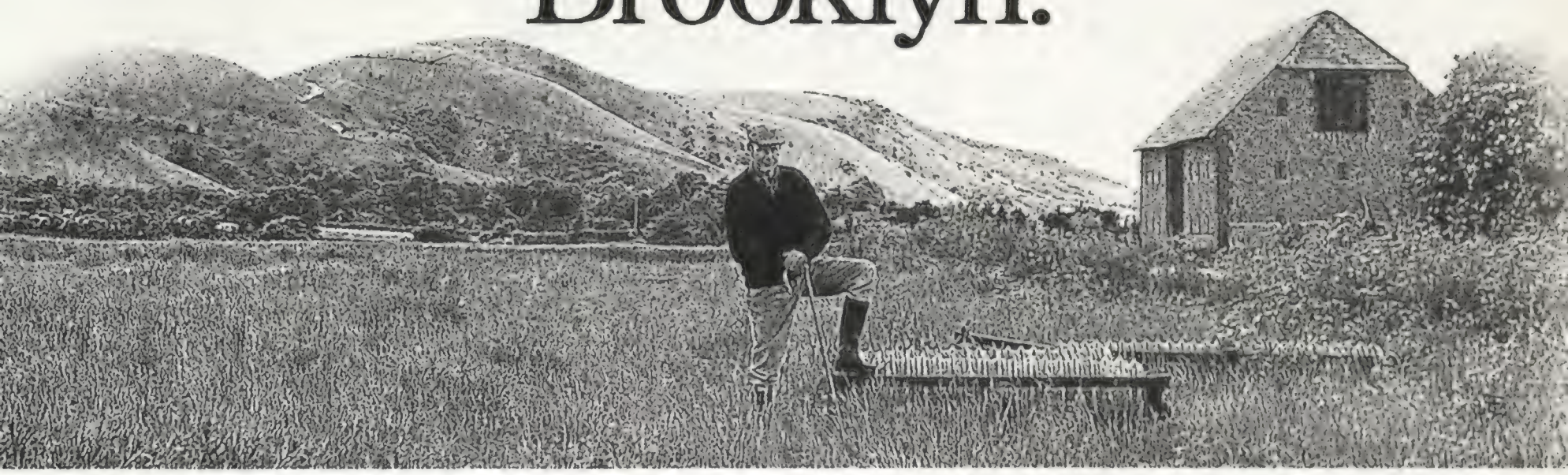
James Smithson died at 64, in 1829, three years after making the will. The nephew died, childless, six years later. Shortly thereafter, word of the Smithson will reached President Andrew Jackson and Congress. At first, there were doubts about accepting any money at all from Great Britain, a country still seen by many Americans as a bully and a territorial threat. The will seemed pretty vague, too. "Increase and diffusion of knowledge" sounded all right. After all, George Washington himself, in his "Farewell Address" to the nation, had asked his countrymen to promote "institutions for the general diffusion of knowledge." But what kind of an institution would we have to create, anyway? A few Congressmen suggested we not bother with it at all. Otherwise, one complained, "every whippersnapper vagabond would send a gift to the United States in order to immortalize his name."

Nevertheless, in July 1836 Congress voted to accept the Smithson bequest. Richard Rush was dispatched to London to get it. A diplomat, recent Vice Presidential candidate and son of the eminent Dr. Benjamin Rush—a signer of the Declaration of Independence—Rush seemed a perfect Galahad to snatch Smithson's bequest from the toils of England's notoriously slow-moving Court of Chancery.

Rush was soon embroiled in British red tape, fighting off assorted claims on Smithson's will. After two years it looked as if he might have to face a decade or so of legal thumb-twiddling. Then, suddenly, with a little backstairs help from a Dickensian law firm—Clark, Fynmore &

James Smithson

A Shetland sweater shouldn't come from Brooklyn.



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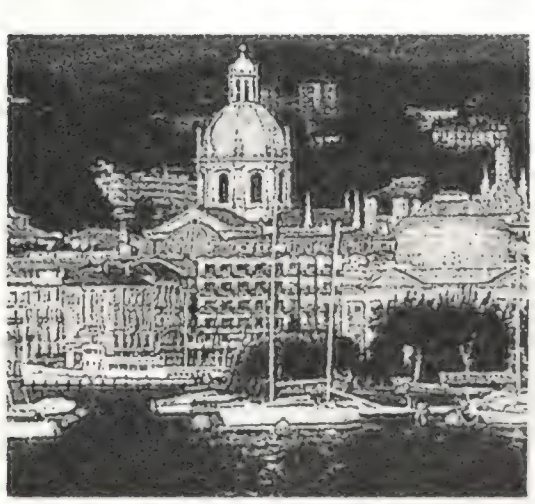

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Fladgate, Solicitors of Craven Street—the Smithson bequest got jumped ahead of some 800 other cases. On May 9, 1838, the court turned over Smithson's fortune to Rush. It came to 92,635 pounds, 18 shillings and ninepence. Rush still had to pay off one family claimant—Madame de la Batut, mother of Smithson's nephew—who got £5,015. That left roughly £87,620 to be converted from stocks and annuities (called "Consols") into hard cash. Paper transactions were so unreliable in those days that Rush decided the best way of bringing the money home to America was in British gold sovereigns.

He wisely waited to sell at the top of the market. "Consols had not brought so high a price for nearly eight years," he wrote home cheerfully on June 13, 1838. There were storage and packing charges, of course, legal fees, insurance and a sales commission of about £800. Small change in the amount of eight shillings and sevenpence was carefully placed in the last bag of gold. In the end Rush was able to put 104,960 sovereigns aboard the packet ship *Mediator*, bound for New York. Each sovereign weighed about eight grams. They were stuffed into 105 sacks (cost: sixpence apiece), each sack holding 1,000 gold sovereigns (except for one with 960). They were packed into 11 boxes, 10 sacks to the box, each box weighing 187 pounds. The lot was simply addressed to "the United States."

"America had specified that it wanted *new* English coins," says Smithsonian numismatist Richard Doty, "so there would be no loss of gold through wear." But in 1838 British sovereigns were not legal tender in this country, so the coins had to be melted down and reminted as American gold pieces. "Our mint people had to add a little copper to give them the correct fineness for American gold coins (less pure than British)," Doty explains. "In effect, we had to 'depurify' the English gold a little before we could strike our own."

The Philadelphia mint turned many of the Smithson sovereigns into the beautiful ten-dollar gold pieces of the time, the Goddess of Liberty on one side with the date 1838, and on the other, a splendid eagle, great wings thrust out, every feather sharply defined. In the early 19th century, known gold deposits were rather scarce in America, the sources mostly found in Georgia and the Carolinas. Ten-dollar

A portrait medal of Smithson, from 1817, rests on a chunk of smithsonite, a mineral he was the first to identify.

eagles hadn't been minted since 1804; Smithson's trove provided a rare chance to reintroduce them. (Today any 1838 ten-dollar U.S. gold piece is almost certainly Smithson gold.) Two of the sovereigns were set aside by the mint for its foreign coin collection and later were presented to the Smithsonian.

It was an amazing gift—$508,318.46—at a time when the yearly budget of the United States was only about $34,000.

Even before the gold eagles were minted, all sorts of people had ideas about what to do with them. The Secretary of the Treasury, Levi Woodbury, won out. He decided to invest the lot in high-return bonds being offered by two new states, one-year-old Michigan and two-year-old Arkansas. No sooner did the eagles arrive in Washington than the equivalent amount was laid out for thousand-dollar, 6 percent bonds—500 for Arkansas and 8 for Michigan. Both states quickly defaulted.

Many Congressmen were just as glad. This was a time when refinement, wealth and, particularly, imported culture were politically incorrect. When Andrew Jackson became President in 1829, he inspired a rush to the nation's capital of tobacco-chewing, gallus-snapping rustics from the southern and western frontiers. Book learning was not high on their list of national priorities, and they figured the gift might be a sign that the Brits were patronizing us.

Such growlers and naysayers ran headlong into former President John Quincy Adams, "Old Man Eloquent," the son of a President and a President himself just before Jackson. After leaving the White House, he returned to Congress as a Massachusetts Representative "accountable to no one but the Nation." He was past 70 when Smithson's gold arrived, but he rallied behind Smithson's "noble and most munificent donation." It must not, he declared, "be filtered to nothing and wasted upon hungry and worthless political jackals."

Adams succeeded in forcing Congress to vote for full replacement of the money lost by Woodbury's bad investments. Once the money was in hand, battles began again about exactly what sort of institution Smithson's gift should be put to. Adams wanted a national observatory. Other Congressmen favored shoring up the capital's Columbian College (now George Washington University), creating an agricultural college, a lyceum for uplifting lectures or, perhaps inevitably, a greatly expanded national library.

Indiana's Robert Owen doubted that there were "a hundred thousand volumes in the world worth reading" and pushed for a teachers college. Adams replied that he would rather throw all the money "into the Potomac" than vote for such a thing.

The year 1846 was in all sorts of ways a fateful moment in America's history (SMITHSONIAN, April 1996). But for the Smithsonian Institution, the year's most crucial event occurred on August 10, when President James K. Polk at last signed the Smithsonian Institution bill into law. Congress had still not given firm orders on what kind of place it would be. But it was agreed that a building would go up on what is now the Mall with suitable rooms for "objects of natural history, a chemical laboratory . . . a gallery of art." A Board of Regents was established, charged with selecting the Institution's first Secretary. Let him worry about how to increase and diffuse knowledge. Princeton's Joseph Henry, a world-famous scientist, got the nod, though not too cheerfully. "Save the great National Institution from the hands of charlatans!" one of the first regents begged him, and he did, moving his family into the Castle, a pinkish neo-Norman pile then just rising on the Mall. Gradually the Institution took shape around it, evolving and expanding over the years until it fulfilled James Smithson's vague wish. His sovereigns had bought something after all.

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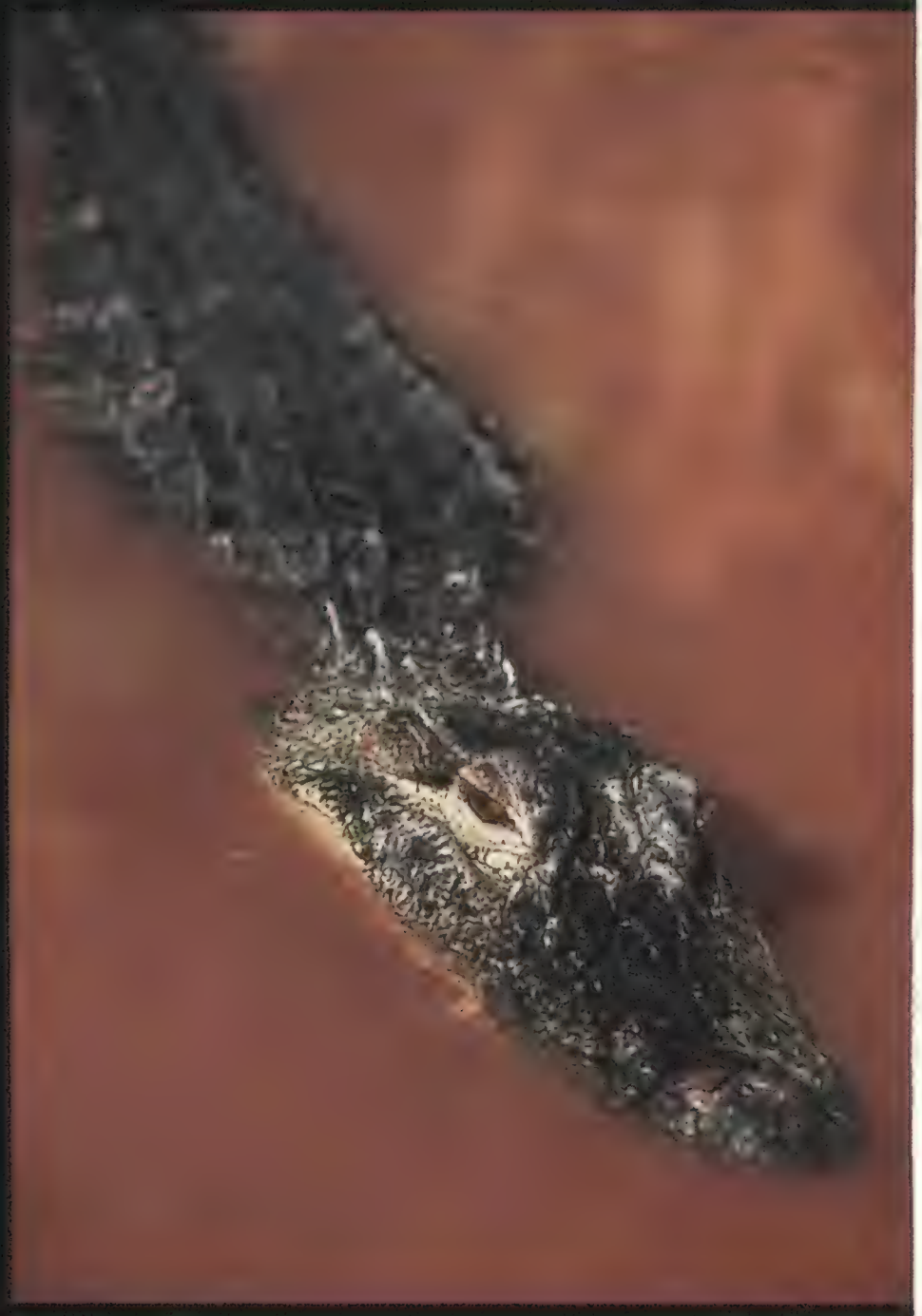

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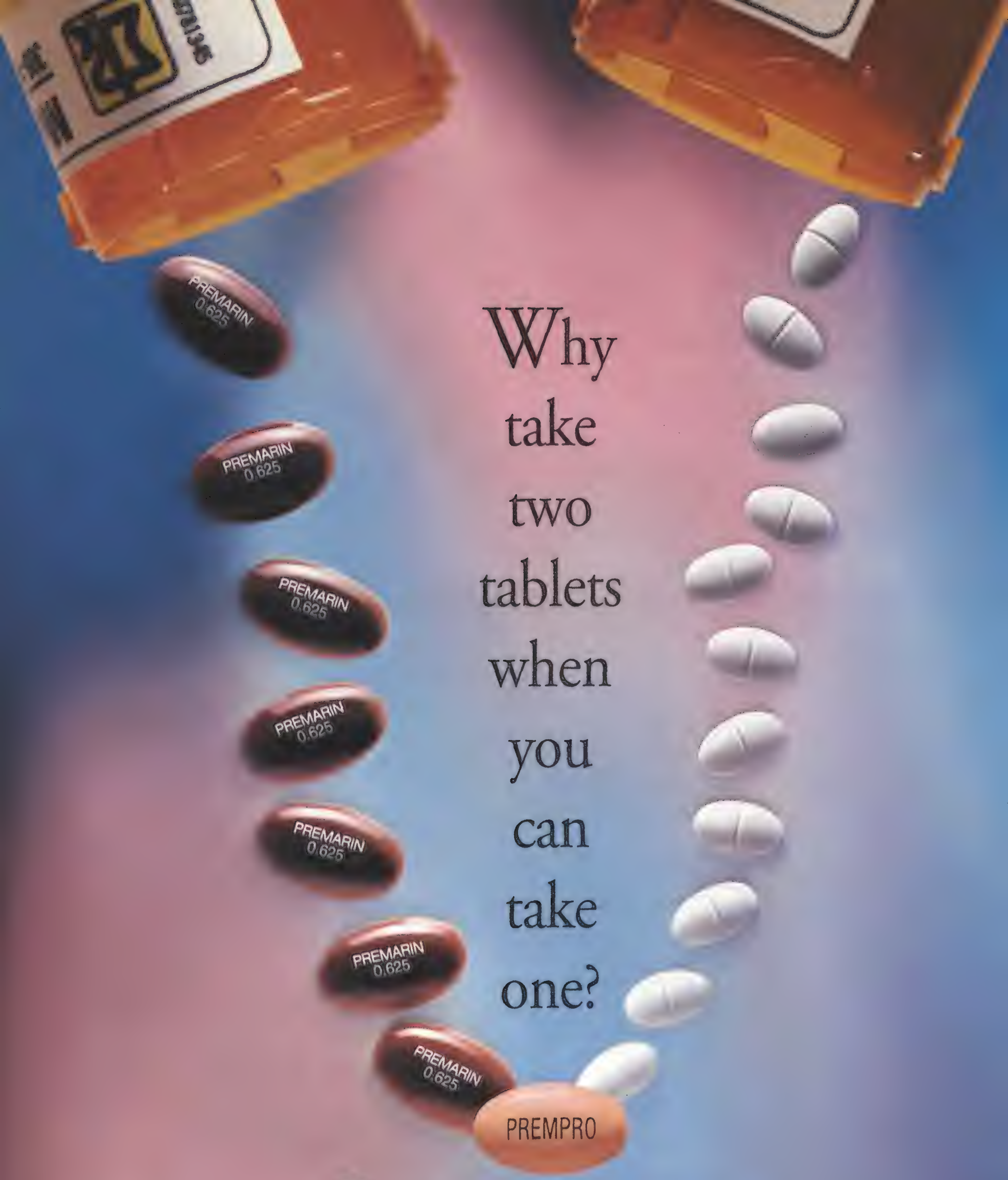

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SIDE EFFECTS OF HORMONES SHOULD BE CONSIDERED. If you have not had a hysterectomy, estrogen alone can increase the risk of cancer of the uterus. The addition of progestin, however, may reduce this risk. That is why many doctors and health care providers now prescribe progestin in conjunction with estrogen for their patients. Progestins may have unfavorable effects on blood sugars, which might make a diabetic condition worse. The most common side effects are breast tenderness, headache, and abdominal pain.

When you speak to your doctor or health care provider about hormone replacement therapy, be sure to discuss your personal and family history of breast cancer, breast lumps, abnormal vaginal bleeding, abnormal blood clotting, severe headache, dizziness, or liver disease. Women who are pregnant should not take hormone replacement therapy.

AN EASIER WAY TO TAKE HORMONE REPLACEMENT THERAPY. Prempro is an easier way to take hormone replacement therapy because it provides you with the two medications you've been prescribed in one convenient tablet. And, because it requires a single prescription, it may even save you money.

WHEN IT'S TIME TO REFILL YOUR CURRENT PRESCRIPTION FOR PREMARIN AND A PROGESTIN, CALL YOUR HEALTH CARE PROVIDER AND ASK ABOUT...

NEW ONE-TABLET PREMPRO™

PREMPRO™

(conjugated estrogens/medroxyprogesterone acetate tablets)

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Please be sure to read the important information on the following page.

BRIEF SUMMARY OF PRESCRIBING INFORMATION FOR THE PATIENT

PREMPRO™ Brand of conjugated estrogens/medroxyprogesterone acetate tablets

This summary describes when and how to use estrogen/progestin drugs and the benefits and risks of treatment.

ESTROGENS INCREASE THE RISK OF CANCER OF THE UTERUS IN WOMEN WHO HAVE HAD THEIR MENOPAUSE ("CHANGE OF LIFE"). *THIS FINDING REFERS TO ESTROGENS GIVEN WITHOUT PROGESTIN.*

Progestin drugs taken with estrogen-containing drugs significantly reduce but do not eliminate this risk. If you use any estrogen-containing drug, it is important to visit your doctor regularly and report any unusual vaginal bleeding right away. Vaginal bleeding after menopause may be a warning sign of uterine cancer. Your doctor should evaluate any unusual vaginal bleeding to find out the cause.

ESTROGENS/PROGESTINS SHOULD NOT BE USED DURING PREGNANCY.

Estrogens do not prevent miscarriage (spontaneous abortion) and are not needed in the days following childbirth. If you take estrogens during pregnancy your unborn child has a greater than usual chance of having birth defects. These birth defects may affect the baby's urinary system and sex organs.

ESTROGEN/PROGESTIN DRUGS

PREMPRO is a combination of two hormones, an estrogen and a progestin. This hormone combination has been shown to provide the benefits of estrogen replacement therapy while lowering the frequency of a possible precancerous condition of the uterine lining. This therapy is not intended for women who have had a hysterectomy (surgical removal of the uterus).

Estrogens have several important uses but also some risks. You must decide, with your doctor, whether the risks of estrogens are acceptable when weighed against their benefits. Check with your doctor to make sure you are using the lowest possible effective dose.

With PREMPRO therapy several menstrual-like bleeding patterns may occur. These may range from absence of bleeding to irregular bleeding. If bleeding occurs, it is frequently light spotting or moderate menstrual-like bleeding, but it may be heavy. Please discuss your bleeding pattern and set up an appropriate schedule for follow-up care with your physician.

USES OF ESTROGEN

To reduce menopausal symptoms. Estrogens are hormones produced by the ovaries of normal women. The decrease in the amount of estrogen that occurs in all women, usually between the ages of 45 and 55, causes menopause. Sometimes the ovaries are removed during an operation causing "surgical menopause." When the amount of estrogen begins to decrease, some women develop very uncomfortable symptoms, such as feelings of warmth in the face, neck, and chest, or sudden intense episodes of heat and sweating ("hot flashes" or "hot flushes"). Using estrogen drugs can help the body adjust to lower estrogen levels and reduce these symptoms. Some women have none or only mild menopausal symptoms; in others, symptoms can be severe. These symptoms may last only a few months or longer. Taking PREMPRO can alleviate these symptoms. If you are not taking hormones for other reasons, such as the prevention of osteoporosis, you should take PREMPRO only as long as you need it for relief from your menopausal symptoms.

To prevent brittle bones. After age 40, and especially after menopause, some women develop osteoporosis. This is a thinning of the bones that makes them weaker and more likely to break, often leading to fractures of spine, hip, and wrist bones. Taking estrogens after the menopause slows down bone loss and may prevent bones from breaking. Eating foods that are high in calcium (such as dairy products) or taking calcium supplements (1000 to 1500 milligrams per day) and certain types of exercise may also help prevent osteoporosis. Since estrogen use is associated with some risks, its use in the prevention of osteoporosis should be limited to women who appear susceptible to this condition. The following characteristics are often present in women who are likely to develop osteoporosis: white or Asian race, thinness, cigarette smoking, family history, and early or surgical menopause.

To treat vulvar and vaginal atrophy (itching, burning, dryness in or around the vagina, difficulty or burning on urination) associated with menopause.

WHEN ESTROGENS SHOULD NOT BE USED

During pregnancy (see Boxed Warning). If you think you may be pregnant, do not use any form of estrogen-containing drug. Using estrogens while you are pregnant may cause your unborn child to have birth defects. Estrogens do not prevent miscarriage.

If you have unusual vaginal bleeding which has not been evaluated by your doctor (see Boxed Warning). Unusual vaginal bleeding can be a warning sign of cancer of the uterus, especially if it happens after menopause. Your doctor must find out the cause of the bleeding so that he or she can recommend the proper treatment. Taking estrogens without visiting your doctor can cause you serious harm if your vaginal bleeding is caused by cancer of the uterus.

If you have had cancer. Since estrogens increase the risk of certain types of cancer, you should not use estrogens if you have ever had cancer of the breast or uterus.

If you have any circulation problems. Estrogen drugs should not be used except in unusually special situations in which your doctor decides that you need estrogen therapy so much that the risks are acceptable. Women with abnormal blood clotting conditions should avoid estrogen use (see **RISKS OF ESTROGENS AND/OR PROGESTINS**).

When they do not work. During menopause, some women develop nervous symptoms or depression. Estrogens do not relieve these symptoms. You may have heard that taking estrogens for years after menopause will keep your skin soft and supple and keep you feeling young. There is no evidence for these claims and such long-term estrogen use may have serious risks

After childbirth or when breast-feeding a baby. Estrogen should not be used to try to stop the breast from filling with milk after a baby is born. Such treatment may increase the risk of developing blood clots (see **RISKS OF ESTROGENS AND/OR PROGESTINS**).

If you are breast-feeding, you should avoid using any drugs because many drugs pass through to the baby in the milk. While nursing a baby, you should take drugs only on the advice of your health care provider.

RISKS OF ESTROGENS AND/OR PROGESTINS

Cancer of the uterus. The risk of cancer of the uterus increases when estrogens are used alone, the longer they are used, and when larger doses are taken. There is a higher risk of cancer of the uterus if you are overweight, diabetic, or have high blood pressure.

The hormone combination you will be taking contains estrogen and progestin. This combination has been shown to provide the benefits of estrogen replacement therapy while reducing the risk of a precancerous condition of the uterine lining.

Additional risks may be associated with the inclusion of a progestin in estrogen treatment. The possible risks include unfavorable effects on blood fats and sugars. Usually, the smaller the dose and the shorter the duration of treatment, the more these effects are minimized. Check with your doctor to make sure you are using the lowest effective dose and only for as long as you need it.

Cancer of the breast. Most studies have not shown a higher risk of breast cancer in women who have ever used estrogens. However, some studies have reported that breast cancer developed more often (up to twice the usual rate) in women who used estrogens for long periods of time (especially more than 10 years), or who used high doses for shorter time periods. The effects of added progestin on the risk of breast cancer are unknown. Some studies have reported a somewhat increased risk, even higher than the possible risk associated with estrogens alone. Others have not. Regular breast examinations by a health professional and monthly self-examination are recommended for all women.

Gallbladder disease. Women who use estrogens after menopause are more likely to develop gallbladder disease needing surgery than women who do not use estrogens.

Inflammation of the pancreas. Women with high triglyceride levels may have an increased risk of developing inflammation of the pancreas.

Abnormal blood clotting. Taking estrogens may increase the risk of blood clots. These clots can cause a stroke, a heart attack, or a pulmonary embolus, any of which may cause death or serious long-term disability.

Excess calcium in the blood. Taking estrogens may lead to severe hypercalcemia in women with breast and/or bone cancer.

During pregnancy. There is an increased risk of birth defects in children whose mothers take this drug during the first four months of pregnancy. Several reports suggest an association between mothers who take these drugs in the first trimester of pregnancy and genital abnormalities in male and female babies. The risk to the male baby is the possibility of being born with a condition in which the opening of the penis is on the underside rather than the tip of the penis (hypospadias). Hypospadias occurs in about 5 to 8 per 1,000 male births and is about doubled with exposure to these drugs. There is not enough information to quantify the risk to exposed female fetuses. However, enlargement of the clitoris and fusion of the labia may occur, although rarely.

Therefore, since drugs of this type may induce mild masculinization of the external genitalia of the female fetus, as well as hypospadias in the male fetus, it is wise to avoid using the drug during the first trimester of pregnancy. These drugs have been used as a test for pregnancy, but such use is no longer considered safe because of possible damage to a developing baby. Also, more rapid methods for testing for pregnancy are now available. If you take PREMPRO and later find you were pregnant when you took it, be sure to discuss this with your doctor as soon as possible.

SIDE EFFECTS WITH ESTROGENS AND/OR PROGESTINS

In addition to the risks listed above, the following side effects have been reported with estrogen and/or progestin use:

- Nausea, vomiting; pain, cramps, swelling, or tenderness in the abdomen.
- Yellowing of the skin and/or whites of the eyes.
- Breast tenderness or enlargement.
- Enlargement of benign tumors of the uterus.
- Irregular bleeding or spotting.
- Change in amount of cervical secretion.
- Vaginal yeast infections.
- Retention of excess fluid. This may make some conditions worsen, such as asthma, epilepsy, migraine, heart disease, or kidney disease.
- A spotty darkening of the skin, particularly on the face; reddening of the skin; skin rashes.
- Worsening of porphyria.
- Headache, migraines, dizziness, faintness, or changes in vision (including intolerance to contact lenses).
- Mental depression.
- Involuntary muscle spasms.
- Hair loss or abnormal hairiness.
- Increase or decrease in weight.
- Changes in sex drive.
- Possible changes in blood sugar.

REDUCING THE RISKS OF ESTROGEN/PROGESTIN USE

If you decide to take an estrogen/progestin combination, you can reduce your risks by carefully monitoring your treatment.

See your doctor regularly. While you are taking PREMPRO, it is important to visit your doctor at least once a year for a checkup. If you develop vaginal bleeding while taking estrogens, you may need further evaluation. If members of your family have had breast cancer or if you have ever had breast lumps or an abnormal mammogram (breast X ray), you may need to have more frequent breast examinations.

Reassess your need for treatment. You and your doctor should reevaluate your need for estrogens at least every six months.

Be alert for signs of trouble. Report these or any other unusual symptoms to your doctor immediately:

- Abnormal bleeding from the vagina.
- Pains in the calves or chest, a sudden shortness of breath, or coughing blood.
- Severe headache or vomiting, dizziness, faintness, or changes in vision or speech, weakness or numbness of arm or leg.
- Breast lumps.
- Yellowing of the skin and/or whites of the eyes.
- Pain, swelling, or tenderness in the abdomen.

OTHER INFORMATION

Estrogens increase the risk of developing a condition (endometrial hyperplasia) that may lead to cancer of the lining of the uterus. Taking progestins, another hormonal drug, with estrogens lowers the risk of developing this condition.

You should know, however, that taking estrogens *with* progestins may have unhealthy effects on blood sugar, which might make a diabetic condition worse.

Some research has shown that estrogens taken *without* progestins may protect women against developing heart disease. However, this is not certain. The protection shown may have been caused by the characteristics of the estrogen-treated women and not by the estrogen treatment itself. In general, treated women were slimmer, more physically active, and were less likely to have diabetes than the untreated women. These characteristics are known to protect against heart disease.

It is important to discuss, in detail, with your doctor or health care provider all the possible risks and benefits of long-term estrogen and progestin treatment as they affect you personally.

This Summary provides the most important information about PREMPRO. If you want to read more, ask your doctor or pharmacist to let you read the professional labeling.

This Brief Summary for Direct-to-Consumer Advertising is based on the current PREMPRO Tablets insert (PI 4665-1) issued November 15, 1995, with the incorporation, in lay language, of pertinent text from the Physician Insert, (CI 4664-1) issued November 17, 1995.

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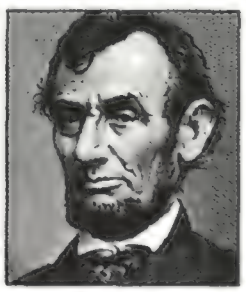

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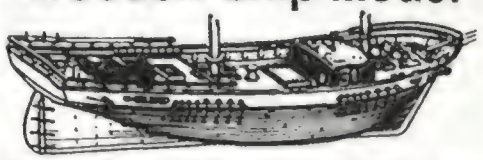

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Smithsonian Highlights

Plan a Smithsonian visit in 1996!

Join in the fun as the Smithsonian celebrates its 150th anniversary with a year of special exhibitions and events. *Receive a free Associates' planning packet.* Write Smithsonian Information, Smithsonian Institution, Washington, D.C. 20560, or call 202-357-2700 (voice) or 202-357-1729 (TTY), 9 A.M. - 5 P.M., Monday-Friday; 10 A.M. - 4 P.M., Saturday-Sunday. *Note:* Parking near the Smithsonian is limited. The Metrorail subway, convenient to all museums, has parking available at some stations.

Begin your visit at the Smithsonian Information Center's Associates' Reception Desk—open 9 A.M. - 4 P.M. daily—in the Castle. Special materials await you there. The National Museum of Natural History's Court Dining Room offers Associates a discount on daily buffet service, 11 A.M. - 3 P.M.

Museum Hours

Smithsonian museums are generally open 10 A.M. - 5:30 P.M. daily, except December 25. Hours at the National Zoo are 9 A.M. - 4:30 P.M. daily for buildings, 8 A.M. - 6 P.M. for grounds.

'America's Smithsonian'

Centerpiece of the Institution's 150th-anniversary celebration, the traveling exhibit showcases treasures from the Smithsonian. Admission is free, but passes are required. Advance passes are available six weeks prior to opening dates for a service fee of $3.50 each by calling 1-800-913-TOUR. For a list of scheduled venues, see page 58.

Special May Exhibits, Events

National Air and Space Museum

The Violent Universe (through October 30) Exhibit looks at the work of NASA's Compton Gamma Ray Observatory.

The Enola Gay (runs indefinitely) Exhibition features the forward fuselage of the *Enola Gay*, the B-29 that dropped the atomic bomb on Hiroshima.

The New Solar System (runs indefinitely) New Einstein Planetarium show takes viewers on a multimedia space odyssey.

National Museum of Natural History

Gem and Mineral Hall Gallery is closed for renovation until late 1997. The famous Hope Diamond is on view on the second floor of the Rotunda.

Giant Squids Permanent exhibition takes a look at the world's largest invertebrates (see page 126).

National Zoological Park

Think Tank New permanent exhibit explores the biology and evolution of animal thinking, focusing on orangutans.

National Museum of American History

Ellington Art Show (through May 26) Display features works by student artists from Washington, D.C.-area schools.

Smithsonian Institution Staff Photo Contest Winners (through September 3) Display of the results of an institution-wide photography contest held in celebration of the Smithsonian's 150th anniversary.

Science in American Life Permanent exhibition tracks advances and discoveries in science over the past 125 years.

National Postal Museum

Located next to Union Station on Capitol Hill, the museum traces the history of the nation's mail service.

The Graceful Envelope (May 1-June 15) Handcrafted envelopes by professional calligraphers from around the world.

The Castle—Great Hall

Smithson's Gift New permanent display tells the story of the British scientist whose bequest founded the Smithsonian 150 years ago (see page 34).

Freer Gallery of Art

The Life of a Japanese Painting (through September 29) Exhibit of recently conserved paintings explores issues of repairing rare, delicate works (see page 94).

Arthur M. Sackler Gallery

Puja: Expressions of Hindu Devotion (opens May 12) Objects made in India between the 9th and 20th centuries that were used in worship.

The Power of the Pen: Islamic Calligraphy in the 14th Century (through May 27) The blossoming of Islamic calligraphy.

Tropes de Teens (1956) by Stuart Davis is currently on view in "The Collection Reviewed: Modern Art" show at the Hirshhorn Museum and Sculpture Garden.

National Museum of African Art
Crowning Achievements: African Arts of Dressing the Head (May 8-August 18) Traditional and contemporary hats, headdresses and hairstyles.
Seydou Keita, Photographer: Portraits from Bamako, Mali (1950-1960) (through July 28) Evocative portraits from Bamako, Mali.

Hirshhorn Museum & Sculpture Garden
Directions—Beverly Semmes (through June 23) Installation of monumental fabric sculpture by the New York-based artist.
The Collection Reviewed: Modern Art (runs indefinitely) Exhibition features works by George Bellows, Piet Mondrian, Alberto Giacometti, Stuart Davis.

Arts and Industries Building
Visual Journal: Harlem and D.C. in the Thirties and Forties (through September 29) Images by such African-American photographers as Robert H. McNeill, Gordon Parks and Robert S. Scurlock.
Discovery Theater
Voyage to Lilliput from Gulliver's Travels (through May 10) *Travelin' Jack & Co.* (May 11) *Kids Kabuki* (May 13-June 7) For times, ticket prices, reservations, call 202-357-1500 (voice or TTY).

National Portrait Gallery
Rebels: Painters and Poets of the 1950s (through June 2) Artists and writers of the Beat Generation and the New York School.
1846: Portrait of the Nation (through August 18) Exhibit focuses on 1846, the Institution's founding year.

National Museum of American Art
Contemporary Printmaking in America: Collaborative Prints and Presses (May 10-August 4) Works on paper created by artists in collaboration with printers.
Gilded Age Watercolors and Pastels from the National Museum of American Art (through May 27) Works by such artists as Childe Hassam and Winslow Homer.

Renwick Gallery
Mark Lindquist: Revolutions in Wood (through July 7) Retrospective surveys the art of the distinguished woodturner.
Lia Cook: Material Allusions (through July 7) Innovative wall hangings.

Anacostia Museum
English and French Caribbean Music in Washington, D.C. (through August) Exhibit examines the development of Washington's Caribbean music community.

Heye Center, National Museum of the American Indian (New York)
Partial Recall: Photographs of Native North Americans (May 19-July 21) Exhibition explores the relationship between photography and identity.
Ancestral Memories: A Tribute to Native American Survival (May 19-July 21) Works by Native American artists commemorate inspirational figures in history.

Cooper-Hewitt, National Design Museum (New York)
Gallery Closing The galleries of the museum are closed for renovation until September 17. Selected exhibitions will be held off-premises.

The Smithsonian Associates, U.S. and International Events

The "Smithsonian Voices of Discovery" program brings a series of free public lectures to Kansas City, Missouri, April 28-May 7. Featured topics include folk art and astronomy. For information, contact: U.S. and International Events, 1100 Jefferson Drive, S.W., MRC 702, Washington, D.C. 20560; or call: 202-357-4800, ext. 274.

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Drummer Harold F. Summey jr. and bassist Michael Bowie perform as part of the Smithsonian Jazz Masterworks Orchestra.

Highlights of the Smithsonian's 150th-Anniversary Celebration

June 26-30 and July 3-7 *Smithsonian Festival of American Folklife* (The National Mall) The Folklife Festival marks its 30th year and the 150th anniversary of the Institution with programs featuring Smithsonian workers and a Smithsonian family album.

July 2-January 5, 1997 *From Smithson to Smithsonian: The Birth of an Institution* (Smithsonian Institution Libraries Exhibition Gallery, National Museum of American History) Exhibition details Smithson's bequest and the debates over its acceptance and use.

July 18-August 3 *Southern Crossroads* (Atlanta, Georgia) The Smithsonian Center for Folklife Programs is collaborating with the Atlanta Committee for the Olympic Games Cultural Olympiad to present a festival of Southern culture.

August 2 *Smithsonian Jazz Masterworks Orchestra* (Atlanta, Georgia) The Smithsonian Jazz Masterworks Orchestra will be performing a tribute to Duke Ellington at the Olympic Arts Festival. **(Performance is fully subscribed.)**

August 9 *Cosmic Voyage* (Langley Theater, National Air and Space Museum) Premiere of the newest Imax release from NASM, sponsored by Motorola.

August 10-11 *Smithsonian Institution's 150th-Birthday Celebration* (The National Mall) Gala festival will feature exhibits, family activities, music and dance performances, fireworks, food concessions, and the installation of the 150th-Anniversary Bell in the Castle Flag Tower at noon on August 10. The Smithsonian Jazz Masterworks Orchestra will perform on August 10, and CBS will broadcast its second one-hour special on the Institution with festival coverage.

September 20 *How Things Fly* (National Air and Space Museum) New gallery will illustrate the principles of flight.

October 25-July 6, 1997 *Red, Hot & Blue: A Salute to American Musicals* (National Museum of American History and National Portrait Gallery) Exhibit tracks history of the American musical.

November 22-April 20, 1997 *American Photographs: The First Century* (National Museum of American Art) See page 116.

December 1996 *Amazonia Science Gallery* (National Zoological Park) New exhibit takes a look at the global reach of Smithsonian scientific activities.

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Highlights Continued

A new book honors the Smithsonian

"On a muggy September morning in 1846," writes author and former *Washington Post* reporter James Conaway, "an unlikely collection of men came together in a vast field" in Washington, D.C. The band of dignitaries included the President, Vice President and Chief Justice of the United States. Their task was to choose a site for a building that would house a new institution. To the east, below the Capitol, a row of ragged shops and houses could be seen. An open sewer flowed nearby. "Envisioning grand architecture in this malodorous commons required imagination," concludes Conaway.

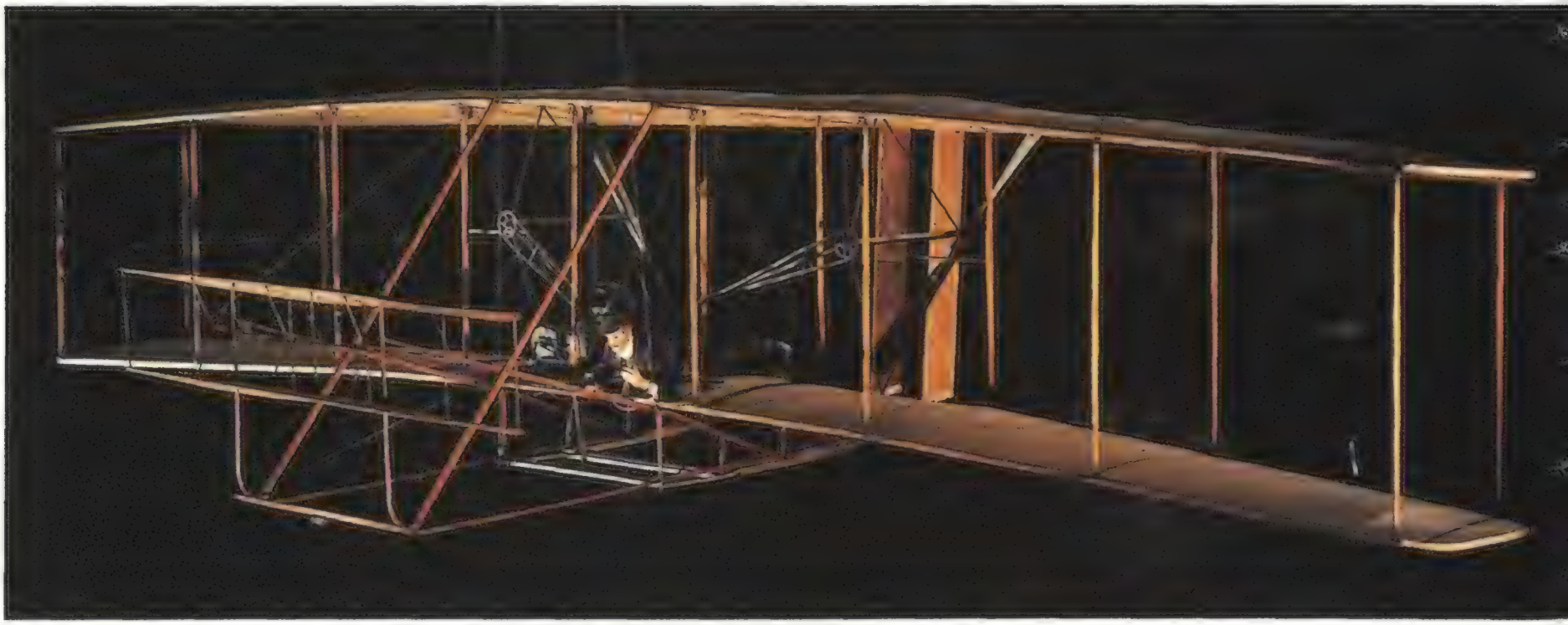
The Smithsonian: 150 Years of Adventure, Discovery and Wonder is a richly illustrated volume copublished by Smithsonian Books and Alfred A. Knopf, Inc. In it Conaway tracks the extraordinary history of the Institution from its beginnings in the legacy of British scientist James Smithson (page 34) to its present status as the largest museum and research complex in the world.

From the gilded confines of Whistler's Peacock Room at the Freer Gallery of Art to the lofty reaches of the rain-forest canopy at the Smithsonian Tropical Research Institute in Panama, Conaway explores the vast resources of the Institution and brings to life the colorful cast of characters who have made the Smithsonian what it is today.
Diane M. Bolz

Original Teddy bear, named for President Teddy Roosevelt, is at American History.

Woolly mammoth skeleton towers over those of peccary and bear at Natural History.

Painted horse struts its stuff on the Smithsonian's popular carousel.



A mannequin of Orville Wright at the controls, the Wright brothers' 1903 Flyer hovers forever aloft at the National Air and Space Museum. The flying machine was restored in 1985.

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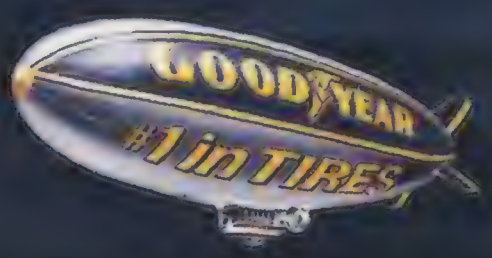

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By John F. Ross

The nation's treasures take to the highways for a 12-city tour

Master forklift operator Daryl Enoch was brought in from Oregon to unload the show in Los Angeles.

The assignment: pick the best of 140 million items, pack them (many are priceless and irreplaceable) and truck them across the USA

It is not an ordinary run for the special agents of the Department of Energy's elite Transportation Safeguards Division. A driving rain beats the pavement of Old Silver Hill Road as the convoy of 18-wheelers roars out of the concertina-wire enclosure at the Smithsonian's Paul E. Garber Facility in Suitland, Maryland. Unmarked vans filled with agents whiz out of the compound and take up positions in front of and behind the big rigs. Usually, their job is to escort nuclear materials—enriched plutonium, nuclear power systems for satellites, Russian warheads on their way to be destroyed. On this wet January day, however, they are guarding an even more valuable cargo.

Inside one van, special agent Farmer Roberts punches a computer console on the dashboard—a loud beeping indicates the convoy is now being tracked by satellite. When Roberts catches me staring at the M-16 near his seat, he grins and says, "We gotta be ready if Murphy comes." Murphy, I later figure out, is a reference to Murphy's Law, the notion that if something can go wrong, it will. Judging by their armament, the half-dozen types of radios and their ever-alert demeanor, Roberts and his fellow agents are ready for anything.

With all this security, you'd think the cargo is the crown jewels. In a way, it is. The trucks contain the hand-picked cream of the Smithsonian Institution's 140-million-object collection, which comprise the artifacts in "America's Smithsonian," the world's largest traveling museum show. Securely packed are Dorothy's ruby slippers from *The Wizard of Oz*, Edison's light bulb, Andy Warhol's *Flowers*, George Washington's green-handled battle sword and a 15-foot-tall totem pole. These and more than 300 other objects, ranging from early Clovis spear points to the Apollo 14 command module, represent the best of the Smithsonian. In a cavalcade sponsored by the Smithsonian's Corporate Partners—Discover Card, Intel, MCI and TWA—they will spend the next two years traveling to convention centers in 12 major American cities. The convoy is headed across the country to the show's first venue, the Los Angeles Convention Center, and an opening date of February 9. It's a curious, reverse pilgrimage in which America's most celebrated icons and treasures will log tens of thousands of miles to visit the American people.

To send these treasures on the road is the brainchild of the Institution's Secretary, I. Michael Heyman, who decided to celebrate the Smithsonian's 150th birthday with a bang. When he formally announced the idea in March 1995, however, a collective groan escaped the lips of the Smithsonian's several hundred curators, the gatekeepers of the Institution's multifaceted collections. Everything but the *Spirit of St. Louis*, the Hope Diamond and the Star Spangled Banner was fair game. Many of the items finally selected had never traveled be-

Photographs by Kay Chernush

Polly Willman drapes bolero jacket over Pat Nixon's Inaugural gown. They will travel in a custom-built crate.

At Chance Rides in Wichita, a painter sprays primer on one of the figures made for the traveling carousel.

fore. Most are fragile, and all are invaluable. Telling the curators that they must release their most precious items is like sending your 16-year-old off in a car alone for the first time—it defies every ounce of common sense, but you must do it anyway.

Senior Conservator Polly Willman was not happy when the order came down. A stylish woman who makes her own well-tailored clothes, Willman looks after the costumes and textiles at the National Museum of American History, a first-rate collection that includes the First Ladies' gowns. It had been standing policy that the gowns would never travel, but the Secretary's order has changed that.

Last fall I went to see her to learn about the challenges firsthand. Inside the conservation laboratory in the basement of American History, Willman pulls a box off a shelf. Inside it I recognize Abraham Lincoln's stovepipe hat, the one, I had learned earlier, he is said to have worn on the night of his assassination. To me, this piece of history seems to tangibly radiate some magical power. With Willman's prompting, however, I begin to see why she regards the hat with horror as well as reverence. Shaped out of cardboard, the hat is covered in a plush fabric meant to simulate fur. The fabric has shed miserably with age, and the hat looks significantly less robust than the image we all carry of our 16th President. Reluctantly, Willman has agreed to send the hat along with the traveling show as long as she and the project conservator and an exhibit designer can build a special mount and case that will be vibration resistant, humidity controlled and never opened. The hat is anchored in the case by a multilayered form of polyethylene foam that fits up inside the crown.

Nearby I see a form that looks like an ancient samurai outfit, an all-white affair with cascading padding and a well-developed torso. On it, Willman will place the red-white-and-blue Olympic jersey of hockey star William Baker, who helped push the fledgling American team to an unexpected gold medal in 1980. The form will mimic the shape of Baker's shoulder pads. I point out what looks like dried blood on the jersey. Such blemishes are left, Willman explains, because they reflect the article's history. To Willman, these clothes are not merely memorabilia—they're historical documents.

They are actually fiberglass molds of originals, many of which were carved in Philadelphia in the 1800s.

Packer Scott Cahlander measures a dogsled once used to deliver mail along a 340-mile route in Alaska.

Willman reaches a compromise with the exhibit designers: only two First Ladies' dresses will travel at a time. Among them is Pat Nixon's yellow silk ensemble with its beaded bolero jacket. The form on which the dress hangs will be secured to the crate by three brass rods that connect from above and below. Willman will be on hand to personally fit each dress into its case.

Without exceptionally good packing and crating, the idea of sending any of these artifacts around the nation would be a nonstarter. In a tough round of bidding, a renowned fine-arts handling company, ARTEX, wins the contract. You name it, they've packed it for travel: the Dead Sea Scrolls for the Library of Congress, a royal Mayan tomb for the National Geographic Society. I meet the project head, Mark Wamaling, at their cavernous warehouse in Takoma Park, Maryland. A solid, likable man with aviator glasses and a mustache, Wamaling tells me that the traveling exhibit business really kicked off with the success of the Metropolitan's "King Tut" show in the 1970s. The now seemingly primitive practices of yesteryear, such as packing objects in wood chips and using nails to secure lids, have given way to an exact science, perfected by a talented cadre of artisans.

I see a shallow drawer containing the Jarvik-7 artificial heart and the CBS microphone used by Franklin Delano Roosevelt to broadcast his "fireside chats." They're encased in a bed of soft white material, which I learn is Nomex, developed for suits worn by firefighters and astronauts. The wood used in the crate into which this drawer slides is sugar pine, which doesn't warp and is so soft that it will compress and not crack. Inside, a layer of Tyvek, a material used in house insulation, acts as a water barrier and keeps the humidity constant.

A couple of weeks later, I travel into the bowels of the National Museum of Natural History, where one of Wamaling's men works on an eight-foot-long jaw of the extinct monster shark, *Carcharodon megalodon.* I watch the slight figure of Lap Tran with amazement as he blithely flits about the rows of still razor-sharp teeth with his glue gun, building the padded wooden braces that will secure the jaw in its crate. A former South Vietnamese farmer, Tran escaped from a Vietcong prison and came to this country, where he discovered he has a genius for crate construction and bracing, spec'ing most of his

A Tucker automobile, one of only 51 ever built, is about to hit the road—but only as precious cargo.

Museum specialist Pete Kroehler brushes and vacuums the choppers that once belonged to a 40-foot shark.

Wrapped for the trip, Rodin's headless *Walking Man* is hoisted out of the Hirshhorn Sculpture Garden.

Michael Semyan and Lap Tran fit axle supports to a Beckley farm wagon built about 1860 in Pennsylvania.

work by eye. His work on the 1860s-era Beckley farm wagon is a masterpiece. The unattached wooden hoops of the hood nestle perfectly in a set of trays, and the bright blue-and-orange-painted wagon rolls into the massive crate and up onto a little rise where braces remove the weight from the axles. Another set of braces prevent the wagon from jostling during transport. So that exhibitors will know how to reposition the braces when they pack up, Tran snips an ace of clubs in half and glues one half to the crate, the other to the brace.

Coordination of this road show occurs in a sprawl of offices at American History. Here, a team of 53 people madly make photocopies, talk on the phone and convene countless meetings in a rush to tack down details that range from access for the disabled to efficient queuing strategies. Many of them worked in 1994 on a Smithsonian show that traveled to Tokyo, but with 12 cities this one is much more complex. And they must assemble the show in one year, not the standard two or three.

In the office one day, I manage to catch the show's designer, Nigel Briggs, a lean, tall Brit who radiates a near-constant buzz of nervous energy. Perched on the edge of his chair, he begins to sketch on the back of a napkin as we talk. The team began, he explains, with the idea of plopping down several hundred Smithsonian objects into a convention hall. How do you organize the pieces? By museum? By their age? As a reflection of the history of the Smithsonian over its 150-year history? None of these suggested the creativity and flexibility that the show required. Fitting them into three broad categories—loosely defined as art, history (both political and social) and science (including exploration)—each one its own gallery, seemed to work better. That's when the curatorial coordinator, Jeff Brodie, suggested that the halls be named "Imagining," "Remembering" and "Discovering." Briggs and his team of designers worked out color schemes that would set the tone and individuality for each gallery—teal and beige for "Imagining," beige and burgundy for "Remembering," green and blue for "Discovering." To decide the color of the carpet, they placed sample squares on the floor and discussed them for days, finally deciding on a light gray weave highlighted with pinpoints of bright primary colors.

Briggs' napkin grows full of arrows and boxes as he describes how the team experimented with grouping objects. Take chairs, for instance. There's a Ngombe throne from Zaire, an innovative modern lounge chair constructed from corrugated cardboard, a wooden chair in the shape of a mermaid carved by a recent Haitian immigrant and a side chair designed by Frank Lloyd Wright. Briggs toyed with separating them, placing one with pieces of folk art, another with design objects. But then he thought, why not put them together? Grouped together, they hint at the universality of the human experience across cultures.

As the planning progresses, Briggs struggles with the question of how to make a museum out of a convention hall that is large enough to house a Boeing 747. To make it intimate and involving, each gallery, he decides, will be a series of rooms linked by hallways, a sort of maze. To give a feeling of familiarity, the walls will rise eight to ten feet, the height of ceilings in the average home. Yet something seems to be missing, something in the middle that will pull everything together. Looking out on the Mall one day, Briggs sees the Smithsonian's carousel and finds the perfect answer.

Several months later, work begins on a 50-foot carousel, specially commissioned from Chance Rides, Inc., in Wichita, Kansas, the nation's largest manufacturer of amusement rides. Chance employee Robert Hall personally oversees the painting of the menagerie of 60-odd fiberglass sea dragons, ostriches, zebras, rabbits,

From right: designers Nigel Briggs, Erin Galbraith and Kathlee Tobin confer; Brendan Traceski drafts plans.

John F. Ross, whose article on scorpions ran last month, wrote the Middle Atlantic volume in the "Smithsonian Guides to Natural America" series.

A guard contemplates a *Pteranodon* on its way into the "Discovering" section of the traveling show. This impressive creature was one of the pterosaurs, the first and largest animals with backbones to take to the air.

tigers, Arabian horses and other animals that will adorn the carousel. In conversation, he refers to each figure as a Dentzel, a Parker or a Muller in a nod to the man who originally carved it. Carving carousel figures, Hall explains, is a great American art, beginning with German immigrant Gusthov Dentzel, who pioneered the modern carousel in his Philadelphia shop during the last half of the 19th century. (Some of his originals are in the Smithsonian collection.) To Hall, the Smithsonian carousel represents a living history of the art. One of his favorite figures is the black stallion, one of C. W. Parker's famous Arabians. A teenage Dwight Eisenhower worked in Kansas sanding carousel figures and probably worked on such horses. To replicate a carousel figure, a mold is made from the original wooden carving. Fiberglass is then hand-laid in the mold, not unlike the way a Corvette body is made. Once Hall receives the figure, he and his assistants will spend up to 60 hours priming and painting it. The figure's iridescence comes from pearl paint, a ground-up mixture of fish scales. Antique glass eyes from a taxidermy shop complete each animal.

Back in Washington, Smithsonian staff dress up a different figure for the show. It is Auguste Rodin's *Walking Man*, a headless and armless torso and legs of larger-than-life dimensions that stands in the Hirshhorn's Sculpture Garden. The curators wrap it in packing blankets. It is as though the naked figure were being bundled against the chill of the December morning. A crane lifts the sculpture high into the air, and it dangles above us like a headless bungee jumper until it comes to rest on a flatbed truck. Two artworks will leave the garden, and curators will play musical sculptures so that visitors will not notice the missing items. When they lift the second piece—Henry Moore's *Draped Reclining Figure*—and look underneath it for the first time in many years, they discover that 3 of the 14 iron bolts connecting the statue to its base have rusted away completely. The curators decide that water from the sprinkling system must have crept between the base and the statue.

In the Hirshhorn's conservation lab, conservator Lee Aks dries the condensation off the Moore with a hair dryer. The rushed schedule means that Aks is unable to remove all the small rust marks that lie where the figure meets the base. Instead he masks the spots with a paint mixture that matches the rich green of the oxidized bronze statue.

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The shark jaw is heavily braced. Playing-card pieces will help guide packers when the jaw is shipped again.

A 15-foot cedar totem pole from Alaska, probably Tlingit, arrives safe and sound in its custom-built case.

Aks' touch-up and the exact condition of the sculpture are carefully noted in a Conservation Report. One report mentions the hole that has worn in the grip of Chris Evert's Wilson tennis racquet, another remarks on the extent of lunar dust smudges on the spacesuit of astronaut David Scott, who commanded the Apollo 15 mission. The show's conservation coordinator, Tracey Shields, relies on this information so that she can accurately monitor the condition of the artifacts during the length of the traveling show. Shields is paid to be pessimistic. She smiles grimly and talks about "off-gassing." Many materials, including certain fabrics and plastics, emit trace gases that can build up inside a closed case and wreak havoc on delicate objects. As a consequence, Shields places some artifacts in separate cases and ensures that those put in the same case will not harm each other. To monitor the environment, Shields places small strips of silver, copper and zinc into many cases. These strips will indicate contamination by revealing corrosion long before the artifacts are affected.

Some artifacts, unfortunately, suffer from "inherent vice." This is the term used by conservators for objects made from materials that are going to deteriorate, no matter what is done to preserve them. Light, as a destructive agent, is a pet peeve of Shields'. She throws the switch on what looks like a transparent tangle of spaghetti on a table and it lights up. Cool to the touch and without the destructive ultraviolet wavelengths of incandescent and fluorescent bulbs, fiber optics are the state of the art in light technology. The 10-to-15-foot lengths can be snipped to fit cases and can be sharply focused to bring alive some of the show's smallest pieces, such as the weevils and the stamps.

Shields is well aware of the potentially damaging impact of sudden, wide changes in temperature and humidity on museum artifacts, a serious problem with "America's Smithsonian" because the items will move from convention hall to loading dock to truck to loading dock to hall 12 times during the next two years. Sudden shifts in humidity can swell and crack fragile materials, such as the paint on furniture or in an oil painting. As a further precaution, Shields will place a device a little larger than a pager into the cases of the show's most delicate objects. These devices each cost $1,000 and can record up to 30,000 readings of temperature and humidity. Through a wire out the back of each case, Shields can retrieve information at any time and reassure nervous curators back in Washington about the exact conditions inside the cases.

The trucks carrying the artifacts across the country are climate controlled and carefully monitored. Truckers Jack and Marcy Eschenbach, a couple from Binghamton, New York, who drive a 500-horsepower 18-wheeler, are used to carrying fine-art shows around the country. Marcy bounces along in her hydraulic driver's

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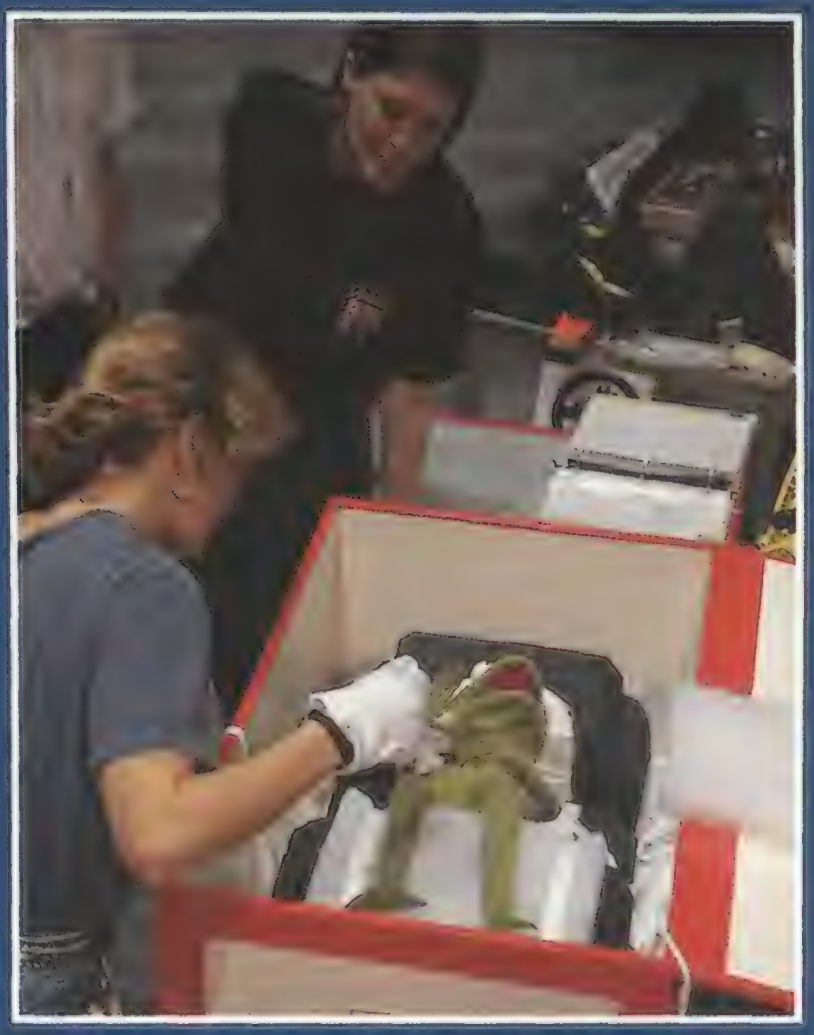

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Another site will be added, and cities, sites and dates are subject to change. Please consult local listings, call 1-800-913-TOUR or check http://www.150.si.edu/150trav/150exhib.htm

seat, barely containing her excitement about transporting Dorothy's ruby slippers. She's got a camera that she plans to use when they start unpacking the crates in Los Angeles. All along their cross-country drive, Marcy and Jack keep a sharp eye in their mirror on a temperature-control device on the front of their trailer. The temperature inside the trailer stays a comfortable 70 to 72 degrees although outside it dips into the teens.

At the Los Angeles Convention Center, Tracey Shields anxiously awaits the arrival of the artifacts. Joined by Smithsonian engineer Sukhinder Sodhi, we view the cooling and humidity-control system. The assortment of humming machines outside the hall was installed just for the Smithsonian exhibit. It connects to ductwork five feet in diameter that snakes across the hall ceiling. It will blow 50,000 cubic feet of conditioned air per minute. Shields and Sodhi tell me they aren't aware of any other traveling exhibit that has attempted to control the climate of an exhibit hall in the center.

A problem has arisen. The specifications for the system assumed that several thousand people would be inside at any one time. Feedback on the potential popularity of the show, however, has revised the numbers upward. While this sounds like good news to me, it has sent Shields and Sodhi into a sweat. Sodhi calculates that 6,000 people will generate heat equivalent to burning 135 pounds of coal: the hall will become too warm for the system to handle. Shields and Sodhi decide to minimize the burden on the system by letting in the excess crowd in pulses of 100 at a time. Later the problem proves not to be serious.

When the trucks arrive at the convention center, I'm watching from high up in the security office overlooking the hall. Much of the walls and partitions are up, and the partially assembled carousel looks like a large rack with hundreds of clothes hangers on it. With the arrival of the artifacts, the security people, dressed in paramilitary fatigues and boots, grow more alert. They have already laid 15,000 feet of alarm wire.

As movers unload the crates from the trucks, people stand around expectantly. One of the trucks has transported a spotless 1948 Tucker automobile (its glittering elegance makes my mouth drool), a lunar rover and the NASCAR stock car in which Richard Petty won his 200th Grand National race. A D-ring on the end of a strap that secured the Petty car has broken on the cross-country caravan, freeing the stock car to rub up against the front of the van. It has lost a slight amount of orange paint from its bumper. The first blood. But, for the next days as the crates are unpacked, no other artifacts show wear and tear from their long journey.

Three men from the National Air and Space Museum have come out to assemble the *Vin Fiz*, the Wright brothers' plane that made the first transcontinental flight, in 1911. Back then, 32-year-old pilot Calbraith Perry

Rodgers made 70 stops on his 84-day flight. More often than not he crash-landed. Today, the *Vin Fiz* has completed its second cross-country trip, and in only three days. I help carry the pieces of the 40-foot wing out of the $35,000 trailer specially built for it. One of the men, Bill Surgi, a Smithsonian volunteer, was on the carrier *Yorktown* when it sank in the Battle of Midway. Long past retirement, he loves airplanes and goes about his work with a lively step. His life spans most of the history of aviation; the decade or two he missed, he knows intimately from working on this aircraft.

No assembly plans exist on this old plane. It is a design, like all Wright inventions, that innately makes sense—at least for these three pros. Still, small white tags with notes on them hang off the tangle of wires that holds the tail together. Emblazoned on the plane's canvas wings is its name, *Vin Fiz*, a flying advertisement for the grape drink made by the plane's sponsor, the Armour Packing Company. What a change from today when the Smithsonian's corporate partners, Discover Card, Intel, MCI and TWA, have teamed up and paid many millions of dollars to send the *Vin Fiz* and the other show artifacts on the road.

Next to the *Vin Fiz* is the Apollo 14 command module, and I look at the plane's insubstantial seat and the reentry burn marks on the capsule and wonder which pilot had more courage. I think of Abraham Lincoln and Andy Warhol, a light bulb and an artificial heart, a farm wagon and a headless, armless sculpture. In a few days' time thousands of visitors will stream by this exhibit and others and be touched by the courage, creativity and inventiveness represented here. "America's Smithsonian" allows people who have never been to Washington, or who might not be able to visit again, a look at the best of the national collections and an opportunity to reflect on who we are as Americans.

An installer readies a "window" in a mural of Mars to hold a case displaying a Martian rock. Blasted into space by asteroid impact, the rock fell in Egypt in 1911. The wires will connect to the security system.

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By David Roberts

The Suyá sing and dance and fight for a culture in peril

For 25 years, anthropologist Tony Seeger has documented the music of Brazil's Suyá and he now leads the effort to protect their rights

Tewensoti (opposite) sports a lip plug, a traditional male adornment abandoned by the younger generation.

Tony Seeger (above) stands out among Suyá friends during the Dance of the Hummingbirds in Lik-ko.

The small man sitting next to me, some 50 years old, was covered with sweat, charcoal and red vegetable dye. Along with his fellow Suyá Indians, Tewensoti was taking a short break from the Dance of the Hummingbirds, which had been going on for hours.

Tewensoti wore a headdress made of a single palm leaf woven into a looping crown; faded cotton knee and ankle wraps; armbands spangled with parrot feathers; and a cotton waistband tied with a drooping tassel that did little to hide his genitals.

Tewensoti's chest was painted with the image of a huge black butterfly covered with red spots. But his most remarkable ornament was a lip plug nearly three inches in diameter, shaped like a hockey puck and wedged horizontally into a hole in his lower lip that had taken years during his youth to stretch to its current size.

The dancers and I sat in the men's house, a thatched building with open walls that stood dead center in the Suyá (pronounced soo-YAH) village. On this late August day, the temperature was a pitiless 95 degrees, while a fitful breeze swirled the choking dust of the plaza.

Anthropologist Tony Seeger, his teenage daughter Elisa, photographer Enrico Ferorelli and I were in the maze of the Mato Grosso, the Great Bush of central Brazil, along the Suyá-Missu River, a tributary of the Xingu, itself a southern tributary of the Amazon. It had taken an arduous four-day, 800-mile journey—by VW

Photographs by Enrico Ferorelli

Seeger now blends easily into Suyá culture, admiring palm-nut jewelry made by Chief Kuiussi's wife Wekwoiyi (above); taking notes on music at breakfast with the chief (below); or leading a sing-along with villagers.

bus along highways that dwindled into forest tracks, then down the river by motorboat—to reach the village in the heart of what the pioneering ethnographer Claude Lévi-Strauss had called "this wild and desolate land." Thanks to Seeger, we would spend ten days among the Suyá, an experience that fewer than a dozen non-Indian parties have ever enjoyed.

Fifty years old, Seeger is the curator of the Folkways Collection and the director of Folkways Recordings at the Smithsonian Institution. He is also the first and only anthropologist to study the Suyá in depth and to live with them for an extended time. "In a sense," Seeger told me, "the Suyá are the linchpin of my life's work. This year I have two goals. I want to record some dry-season ceremonies I've never seen. And I want to help the Suyá document ancestral land claims—land their grandparents used and that ought to be theirs."

Seeger's anthropological mission dovetails perfectly with his work at the Smithsonian. One of Folkways' mandates is to document the music and dance of ethnic minorities all over the world, before those arts slip irrevocably into what folklorist Alan Lomax has called "the cultural gray-out of the world." Folkways has issued a recording of Suyá music, and Seeger's program enables the Suyá to videotape and record their dances.

Beginning in 1971 Seeger, with his wife and invaluable companion, Judy, spent 15 months among the Suyá gathering insights for his doctoral dissertation. Tony and Judy became the first non-Indians ever to learn the Suyá language, a complex tongue in the wide-ranging Gê family of Indian languages. Tony has returned periodically to visit since 1976. Two of his books, *Nature and Society in Central Brazil* (1981) and *Why Suyá Sing* (1987), are lucid treatises that have had a broad impact on the disciplines of anthropology and ethnomusicology.

Over the years, from the Suyá point of view, Tony

Seeger has become "our white man"—a champion of the people's rights in the face of a sometimes crushing federal bureaucracy and the incursions of land-hungry ranchers who threaten the Suyá on all sides. As I was to see vividly during my time with them, the crisis of cultural survival that the Suyá (and many other Brazilian tribes) face today has never been more acute.

At the time of the Portuguese discovery in 1500, there may have been five million Indians living in what is now Brazil. Five centuries, however, of warfare, slavery, genocide and—most deadly of all—European diseases have taken a toll: today's Indian population is a mere 250,000.

Among the fiercest and least-known indigenous peoples in Brazil were the Suyá. Although they may once have numbered in the thousands, only 180 Suyá live today—all of them in Lik-ko, the concentric village that we visited on the riverbank in the Mato Grosso.

Tewensoti got to his feet to resume the Dance of the Hummingbirds. He took his place with more than 30 men and boys; trailing them came some 15 women, naked except for body paint, necklaces and waistbands of bright-colored beads. (When the Suyá have a ceremony, they take off their clothing and paint their bodies because it is considered much more beautiful.)

The men set off, singing as they jogged, toward Tewensoti's house. Inside the dwelling the male dancers formed a large circle. Behind them stood the women.

Like virtually all Suyá dances, the Dance of the Hummingbirds was built around the repeated heavy stomp of the men's right feet, which laid down a solid 2:4 tempo. The only instrument was a gourd rattle. The singing was like nothing I had ever heard. A low-voiced unison

David Roberts writes frequently for SMITHSONIAN. *His book on the Anasazi,* In Search of the Old Ones, *was recently published by Simon and Schuster.*

At dawn, hunters (left) who shot caimans during the night share the meat among the villagers. In a dry season dance (above), both men and women participate.

dirge, ranging among only four or five notes but subtly syncopated with attacks that anticipated the beat, formed its foundation. Above that, shrill cries—hawks' keenings, to my ears, rather than the trills of hummingbirds—flew antiphonally across the dark indoors.

One man in the middle of the jogging column stuck out incongruously, a head taller than anyone else, his pale white skin clashing with the olive hues around him. Over the years, Tony Seeger had learned the Dance of the Hummingbirds well enough to be invited to perform it. The chief's women had painted Tony's legs and torso, teasing him for his hairy chest (to the Suyá, body hair is repellent, more appropriate to monkeys than to men). He let the men adorn him with a palm crown, and leg and arm wraps. Now he looked exhausted, though he gamely kept singing and stomping.

One of Seeger's cardinal accomplishments as an ethnographer has been to discover the centrality of song and dance to many so-called primitive cultures. Most anthropologists before him had tended to regard music and dance as peripheral—mere entertainment, a kind of second-rate folklore, less important than myth.

Seeger's own background, however, is steeped in music: his uncle is Pete Seeger, the famous folksinger, and his grandfather Charles Seeger was a seminal musicologist. Among the Suyá, Tony was from the outset a rapt and percipient witness of song and dance. Early on, one of Tony and Judy's most important contributions was to sing their own folk music and play the banjo and guitar. Song served as the first deep cultural exchange.

In 1972, as Tony slowly learned the Suyá language and began to glimpse the people's worldview, he came to see that the Suyá's very social coherence hinged on song and dance. Starting from the simple perception that the Suyá spent three to four hours a day hunting and gathering food and an equal amount of time singing and dancing, he eventually recognized that, as he puts it in *Why Suyá Sing*, the people make music to "re-establish the good and beautiful in the world." As one man told him, "When we stop singing, we will really be finished."

The Suyá were first contacted by outsiders in 1884, when the daring German explorer Karl von den Steinen pushed through their remote heartland. Then the Suyá effectively disappeared from Western ken until they were rediscovered by airplane in 1959.

Two ethnographers made brief forays among the Suyá

It's the Suyá way of expressing communal happiness. Kangan, the chief's younger wife (right), spins cotton in the dwelling where a family of 20 lives.

in the 1960s. They found the people at a nadir of population: at lowest count, they numbered only 58. Both scholars were convinced they were seeing a tribe on the verge of extinction, their rituals lost. In the words of one, Amadeu Lanna, the Suyá were a "society in ruins."

The obstacles that faced Tony and Judy Seeger in 1971 were herculean. Eight months of bureaucratic shenanigans forestalled their arrival in the Suyá village: only much later did Tony learn that the Brazilian government was pushing a new logging and mining road through the territory and wanted no unfavorable publicity from liberal anthropologists.

When they finally arrived, the Seegers had to travel so light that they were utterly dependent on their Suyá hosts for food and shelter. They soon realized that unless they helped find and prepare food, they would not eat. One day Tony and Judy received one nut apiece for sustenance; in four months Tony lost 30 pounds.

Tony was assigned to go fishing with a 10-year-old boy who, as Tony wrote in *Nature and Society*, "was a far better fisherman [than I] but who suffered from convulsions and needed a companion to keep him from falling out of the canoe." By the end of his 15 months among the Suyá, Tony recognized, "I could paddle, fish and hunt about as well as a 12-year-old."

During his first four months, Tony was convinced, as Lanna had been, that he was in the midst of a "ritually sterile" society. "I decided that I had asked all the right questions but that the Suyá did not know anything." It was only upon returning in the more difficult rainy season of January that he began to fathom the true intricacy of Suyá life. For the people indeed concentrated their spiritual life into the rainy season.

That first entry into the Suyá world was also an act of considerable courage. In 1971 the people had dealt with outsiders only on the most glancing terms. As Tony and Judy headed into the Mato Grosso, other Xingu Indians told them that the Suyá would surely kill them. Such fears were far from groundless, for during the 75 years of noncontact after Von den Steinen's visit, the Suyá periodically made their existence known by raiding and murdering Indians from other tribes.

Though our ten days in Lik-ko required little physical exertion, I found the visit psychologically exhausting. Never before had I submitted my daily life so entirely to the control of hosts whose whole world seemed utterly

alien to me. I struggled to voice a few intelligible phrases in Suyá, particularly the versatile *mbet-kumeni* (an all-purpose "very good" or "thanks").

We made our home in the house of the chief, a powerfully muscled 45-year-old named Kuiussi. Tony strung his hammock above the dirt floor, while Enrico and I pitched our tents under a pair of mango trees.

Though we had brought along rice, beans and coffee, we were obliged to share all our food with Kuiussi's considerable extended family. The usual fare, three times a day, was *beiju*, a tasteless tortilla made of grated manioc, and fish, usually largemouth bass. As treats, we drank *kwara kango*, a sweet boiled manioc beverage; ate the occasional banana or sweet potato; and gorged on honey. The rarest treats of all were our few bites of the hunters' catch: roasted turtle, boiled turtle eggs and fried caiman (like crocodile, and as tasty as good chicken).

The Suyá seemed to have no concept of what we call privacy. If I sat on the riverbank and tried to read a book, a dozen kids stood one foot away, patiently observing my arcane rite. As Tony clarified, "Among the Suyá, wanting to be alone is strange, even witchlike. Thoreau would not have been esteemed here."

On our second day, three Suyá men took Enrico and me fishing. We motored several miles downstream to a glassy eddy. An excellent fisherman, Enrico had a high-tech spinning rod. He cast and retrieved fruitlessly for 20 minutes while the Suyá smiled slyly at each other. Finally one of the men borrowed Enrico's rig and caught a fish on the first cast. Cutting pieces from the fish, the men baited hooks that were tied to long pieces of nylon leader wrapped around small boards.

Holding the boards in their left hands, the men swung the baited hooks like lariats, then cast as far as Enrico could with his rod—and with much greater accuracy. Every other minute, someone landed a fish; several were three feet long and probably weighed ten pounds. Instead of using a net to land the fish, the Suyá played them close to the boat, then stabbed them with arrows.

I was dazzled by the prowess of the fishermen. But later, Kuiussi gloomily told us that fishing had got much more difficult in the past few years. Thanks to soybean farmers and ranchers upstream, the crystal-clear Suyá-Missu has turned green and murky. The bulk of the pollution is the work of one megalomaniacal rancher who illegally dredged channels between meanders of the river to drain his swampland. The man was recently fined and his dredge confiscated, but the murkiness will take years to clear up. Just a few years ago, the Suyá fished mainly with bow and arrow; the water was so clear they could strike their targets at great distances.

The Suyá were limitlessly curious about the antics of Tony's two white friends in their midst. Enrico's photographic gear seemed like some conjurer's paraphernalia. Thanks to the endless face-making he used to charm his subjects and to a kind of klutzy, senile shuffle he affected, Enrico won a curious sobriquet. In Suyá society, once past a certain age, a person becomes one of two things: *wikenyi*, a clown, or *wayanga*, a witch. Enrico emerged as *wiken me jin kande*: "the old clown who is in charge of taking our pictures."

Tony, after all these years, was simply *Tony*. For him, a typical day in Lik-ko began around the breakfast campfire in a long discussion with the chief. On our second morning, Tony delivered his gifts to Kuiussi: 1,200 fishhooks, 35 packs of tobacco, 75 pieces of cloth, 10 kilos of colored beads (made in the Czech Republic), as well as many rounds of ammunition for Suyá rifles and shotguns. We all watched as Kuiussi carried the booty to the men's house, where he divided the fishhooks, inviting each man to take his share, then the bullets, and so forth.

Glued to the tube, watching Suyá dances

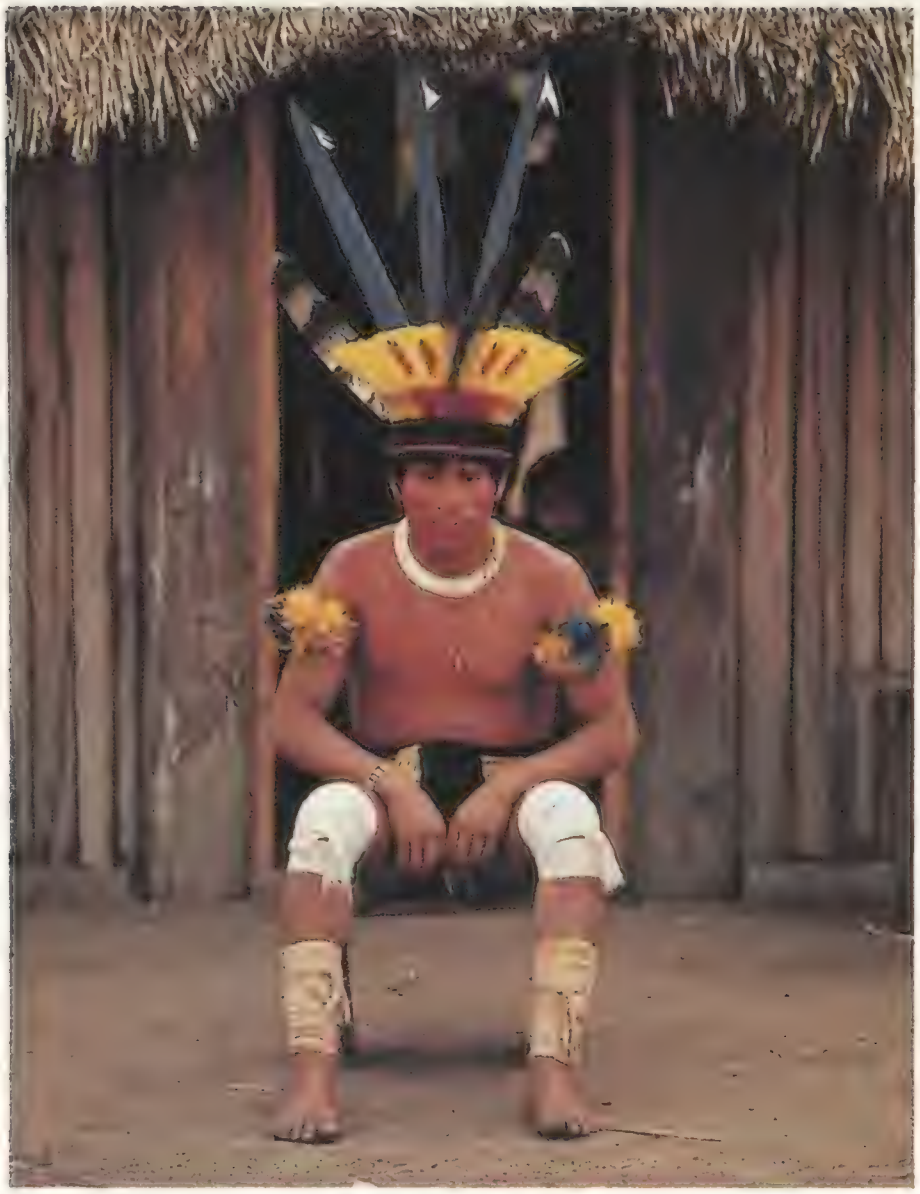
In midmorning Tony continued training several young men to operate a camcorder to record their own dances and music. To aid this effort, we had brought along a 14-inch color TV and VCR powered by solar-charged batteries. (These, like the Suyá's video camera and the motorboat that brought us to the village, were supplied by the Grateful Dead's Rex Foundation, which has been assisting Tony for years in his Suyá projects.) A sizable portion of the Suyá village spent the afternoon glued to the tube watching tapes of North American Indian songs and dances—which the Suyá found endlessly fascinating—and tapes of their own dances, shot the year before.

Next, Tony took a walk through the gardens with several elders, engaging in learned palaver as to the best soil for a certain kind of manioc, the optimal time for burning one's field. Later, Tony participated in the Dance of the Hummingbirds, dropping out now and then to record the ceremony on audiotape and video.

Over the years, Tony's commercial recordings of Suyá songs have brought the people modest royalties (Folkways makes no profit from such disks, which make up a substantial portion of its archive). "It was a collaborative project with the Suyá," he explains. "It spoke to their interests and their art. And I learned from them how to collaborate with other cultures."

Before dinner, Tony would write up his notes for the day—for there was always more to learn. After dinner, he took out his banjo. One evening he regaled all of us with a sing-along. His tour de force was a Suyá adaptation of a Pete Seeger song called "Abiyoyo" (itself based on an African folktale). Singing, strumming and acting

A woman has her body decorated with vegetable dyes; to the Suyá, painting the body is like dressing up.



After Benti was photographed in Tarawana Dance regalia, he switched to soccer clothes, his favorites.

out an epic parable, Tony terrified some of the kids by impersonating a monster from their own mythology. Finally, late at night, droopy with exhaustion, Tony sat in the men's house while the elders smoked in the darkness and told tales of their grandparents' time, of the circuitous migration over the centuries that had brought the people to the banks of the Suyá-Missu.

Gradually we got to know aspects of the characters of individual Suyá. One of the most interesting was Ntoni, a wiry 40-year-old. He was arguably the best hunter in town, as we saw when he pulled the boat up to shore one afternoon with a cargo of 30 turtles (still alive), a hundred turtle eggs, a couple of caimans and a hulking black tapir, already quartered and smoked.

New songs from animals and trees

But Ntoni was also the only current example of what the Suyá call a "man without spirit." We might translate this loosely as a shaman. A few years ago, during an illness, Ntoni had lost his spirit: this left him in a precarious state, but attuned him uniquely to hear things other Suyá could not. The people believe that new songs must be learned from animals and trees. Ntoni was the only Suyá who could hear what the animals and trees were singing; he was thus the sole source of new songs.

Watching the children frolic in the river, the men dancing for hours without fatigue, the women placidly grating manioc or weaving cotton hammocks on their looms, I was struck by the boundless energy and joy of the Suyá. I said to Tony one day, "These people don't know the meaning of depression." He thought for a moment, then rejoined: "Except the chief. He has the cares of his people on his shoulders." It was true. Kuiussi walked around his house with a perpetual frown on his brow, chain-smoking. He and Tony engaged in long, thoughtful dialogues in Suyá.

For despite the zest with which the people greet their daily chores and play, the Suyá, like so many Brazilian Indians, are beset by threats to their very existence. They have no source of cash income. Although the large Xingu Reserve, which shelters many tribes, covers some 7,000 square miles, its fatal flaw is that none of the headwaters of the branches of the Xingu are contained in the reserve. Whence the green murk we saw sliding by Likko's shore, and the daily smog from fires in the distance, as homesteaders burned the forest to clear land.

The most immediate threat comes from those homesteaders. Many are Brazilian peons, desperately poor, who see no alternative to illegally squatting on tracts of "useless" forest (nor is the government aggressive in evicting them). Others, equally poor, are mercenaries hired by rich landowners to carve farms and ranches into the dangerous fringe of Indian territory.

In recent years, the Suyá have painted themselves

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Kuiussi is a powerful chief, in part because of his large family. Here, four generations are represented.

Kuiussi, at center, holds his grandchild; his mother is seated at right; and his two wives stand behind her.

black, armed themselves with their wooden spear-clubs and forcibly evicted terrified squatters. An odd collection of booty from these raids was scattered around the village: a treadle sewing machine, constantly used by the Suyá; a big Coca-Cola cooler for which no use had yet been divined; folding aluminum chairs; and guns and gasoline. A few years ago, innocent of its value, the Suyá had rolled a squatter's jeep into the river.

So far no reprisals have come. But the Suyá are aware that other tribes have been decimated by the savagery of professional goons and thugs hired by the landowners to mete out vengeance.

One day a small plane flew over, 2,000 feet up. Kuiussi seized his shotgun and fired a shell at it—more a symbolic act than a practical one. Another day, the Suyá got word through a radio broadcast that "men with pots on their heads" (helmeted police or soldiers) were coming from upriver. The Suyá men cut short their dancing, gathered in the men's house with their clubs, and awaited the attack. The rumor turned out to be a false alarm.

The fear of a final battle is no idle one. Two dismal events stand as mileposts in Suyá oral history. The first came in 1915 when, without warning, a horde of Juruna Indians bolstered by rubber-tapper allies attacked at dawn. Many Suyá men were killed, many women and children were stolen, never to be seen again, and the village was burned to the ground. The very culture of the Suyá was devastated by this massacre: a number of old ceremonies were never again performed.

Then, in the 1960s, the Western Suyá, cousins of the Suyá in Lik-ko, had been invited to a great feast of meat provided by ranchers claiming to want peace. A white powder was sprinkled on the meat. The Suyá were given something to drink, then sent home. On the way back, the poison started to work. Those who had eaten much died; those who had eaten less got desperately sick.

One day we took a reconnaissance trip up the Wawi, the only tributary of the Suyá-Missu that still runs clear. Thanks to the ranchers, the Suyá must now boat 20 minutes upriver, burning precious gas, to get the good drinking water that they once had simply dipped their pots offshore to retrieve. The purpose of our ride was to document Suyá land claims. The borders of the Xingu Reserve are a legalistic fiction.

Much farther up the Wawi, well outside the reserve, Tewensoti pulled us to the bank. This obscure plot of forest had been the banana garden of Tewensoti's grandfather—four hours by motorboat from Lik-ko, a two-day paddle in that patriarch's time. Tony took notes and plotted the garden on a map. If he can help the Suyá document historical use of land outside the reserve, there is hope that the official boundaries of the Suyá domain will be enlarged.

Admiring the careless verve with which the Suyá go at life, I was tempted to sentimentalize them. Now and then, however, a vignette or a piece of knowledge hint-

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ed at a dark side. The story of Peti, as Tony recounted it, epitomized a Suyá worldview hard for even the most tolerant cultural relativist to countenance. For more than a decade, Peti had been Tony's most valuable aide, an encyclopedic font of Suyá myth and lore. In 1984, when his wife fell ill, Peti accompanied her to the big city of Goiania. It was his first time "out."

His Brazilian friends were preoccupied with getting the wife good medical attention; no one thought to look after Peti. Ignorant of urban life, he walked in front of a speeding car and was killed instantly. His body was brought back to the Suyá village, where its arrival launched intense mourning.

A Brazilian doctor happened to be in the village, giving inoculations. According to Suyá belief, no death is an accident: the demise of any person is the result of witchcraft. Realizing that the people were trying to determine what witch had caused Peti's death, the doctor intervened. He showed the people Peti's crushed skull and massive bruises: the man was hit by a car, it was nobody's fault, the doctor pleaded, to no avail. After several days, suspicion focused on a Western Suyá man who had settled among his Eastern cousins. Several Suyá ran him down and killed him with their clubs.

As I walked about Lik-ko, the signs that modern Brazilian life had transformed the village were all around me. A pair of regulation-size soccer goals faced each other across the plaza. Several times I joined in spirited matches of *pensogtagu* ("rubber hit") with the teens. They played a skillful, disciplined, egalitarian game, with much passing and little showing off.

One thatched dwelling in Lik-ko has been turned into a school, where youngsters learn not only Portuguese but to write a transliterated Suyá. Like most native peoples all over the world, the Suyá are pleased to acquire such Western garb as T-shirts, shorts and running shoes. In Tony's view, far from corrupting the Suyá, modern technology can vitally aid a people. Suyá culture remains essentially intact. There is no alcohol problem yet. Not a single Suyá has converted to Christianity or decided to make a home "outside" in a Brazilian city. Some crucial pieces of Suyá identity are, to be sure, being lost. Only Tewensoti and another older man, Robndo, still sport lip plugs; the younger generation rejects these disfiguring ornaments. Sometimes the dances collapse in peevish recrimination, as the elders scold the giggling young men for not learning the words and the music.

Although a population of 180 may seem marginal, among the Suyá it represents a stunning rebound from a low ebb of 58. On the whole, the people live today in good health, and it seemed to me that there were more babies and young kids than any other age group.

On our last full day with the Suyá, we went on an old-fashioned clambake. Piling into the two motorboats and numerous dugout canoes, 63 Suyá men, women and children made their way downriver to a small lagoon.

In the undergrowth, women built small fires. The men waded into the water with loud whoops. They carried bundles of timbo, a vine that they beat with sticks as they waded, releasing a nerve poison that is harmless to humans but that momentarily stuns small fish.

With raucous cries, small boys and girls waded after them with their toy-size bows and arrows. In half an hour the gang had captured several hundred small fish. The women tossed them on the fire, and soon we were

A mother and children bathe in the Suyá-Missu. Once clear, the river is now murky from upstream dredging.

all eating roasted fish washed down with kwara-kango.

As I sat watching this festive idyll, my head was full of the deep, hidden textures of Suyá life that only Tony's years of diligent research had uncovered. I thought of how many Indian peoples in Brazil had vanished beneath the tide of extinction without a Tony Seeger to fathom and record their vision.

My ten days in Lik-ko had given me a profound admiration for what I can only call the heroism of Tony's mission. In one sense, he was a throwback to the great field ethnographers such as Margaret Mead and the Smithsonian's Frances Densmore, who had plunged unaided among an alien people and stubbornly won the right to learn from them. At the same time, he was a prophet of the new, politically committed anthropology, bringing camcorders and land-claim lawsuits to bear on that people's fight for a place in the modern world.

Back in Brasilia, I asked Tony what he thought the greatest threat to the Suyá was. Expecting talk of ranchers and governments, I was surprised by his answer. "The encouragement of individualism," he said, "as opposed to the collective tribal good. I'm already seeing signs of it. Our rice and beans and coffee, for instance, weren't shared much beyond the chief's family, as they would have been in the 1970s."

Then Tony reflected on his life's work. "My one insecurity," he said, with characteristic humility, "is that I've created a 'Suyá' in which the reader believes, but that may not be true at the deepest level. What if I haven't asked the one question that's most important?"

By Jon Krakauer

A new vision for a museum on the Mall

Architect Douglas Cardinal hopes to realize his plan for making the National Museum of the American Indian into a Washington landmark

In the heart of Washington, D.C., tucked between the National Air and Space Museum and the U.S. Capitol, lies a wedge-shaped vacant lot that goes largely unnoticed by the crowds on the National Mall. But this patch of trampled grass won't be vacant—or overlooked—much longer. Six years hence, if the preliminary plans are approved and Congress provides funding, a dazzling new edifice will stand on the site: the National Museum of the American Indian (NMAI). The museum presents the first opportunity to create in Washington a place that honors the Native inhabitants of the Americas. It also promises to be one of the most unusual and talked-about buildings in the country, an assemblage of sweeping curves and gravity-defying planes unlike anything seen before in Washington.

Much will be riding on the new museum's cantilevered shoulders. Slated to occupy the last scrap of available real estate between the Capitol and the Washington Monument, the NMAI will in a very real sense consummate the Mall. The buildings lining this strip of hallowed soil are architectural monuments—icons of American culture and history. Tinkering with their collective visage is not an act to be undertaken lightly.

Douglas Cardinal, the 62-year-old Canadian architect chosen as project designer for the NMAI, is quick to admit that he and the rest of the design team have their work cut out for them. "There is no getting around the fact that this museum is supposed to be the keystone of the Mall," muses Cardinal, a trim man with close-cropped dark hair framing a high forehead. "It has to complete the Mall as an architectural composition. But the NMAI also has to stand on its own as an expression of the Indian voice. Indians want it to look like it belongs on the Mall, and they want it to be functional, but they also want it to be more than just a building. There is a widely held feeling that this museum should be a powerful statement."

Fittingly, Cardinal is himself Indian, descended from Blackfoot and Métis. But it was his reputation as an architect that won the NMAI commission for him and the Philadelphia architectural firm of Geddes Brecher Qualls Cunningham. Although his name is familiar to relatively few Americans, north of the U.S. border Cardinal is widely known for designing the colossal Canadian Museum of Civilization in Hull, Quebec (SMITHSONIAN, March 1990). Covering nearly a million square feet, it has been called the most significant building in Canada after the Parliament buildings.

A surprising number of Cardinal's buildings—indeed, almost all of them—were commissioned by government agencies or other public entities. One might reasonably assume, therefore, that his designs would be conservative, conventional, exceedingly bland. In fact, nothing could be farther from the truth. Take, for ex-

Douglas Cardinal, lead architect for the proposed National Museum of the American Indian, which would complete the Mall (opposite), developed preliminary plans after extensive meetings with tribal groups.

ample, the Edmonton Space & Science Centre, a Cardinal design erected in the early 1980s that the locals immediately adopted as one of that city's signature buildings. Among the most recognizable landmarks in the province of Alberta, at first blush it looks as though an immense flying saucer has touched down on a swath of northern prairie: round in form, clad in white metal, the building sprouts all manner of fins, antennas and futuristic embellishments. The effect is striking.

Searching for words to describe Cardinal's singular style, architecture critics have relied heavily on such adjectives as "organic," "free-form" and "curvilinear." The Canadian magazine *Observer* describes one of his first buildings—St. Mary's Church in Red Deer, Alberta, completed in 1968—thus: "From the outside it resembles a decaying castle buttressed by brick silos. Its sinuous walls move up and down like hills. Inside, a winding brick corridor leads to the building's core, revealing a spacious altar room with pews that radiate out from the altar like ripples of water. . . . Visitors variously compare the building to the catacombs, a huge seashell or a cave."

The architect traces his fondness for organic shapes

The Edmonton Space & Science Centre, built in the early 1980s, has become a landmark in Alberta, Canada. Cardinal wanted the building, with its circular plan and metal cladding, to convey the idea of a spaceship.

to a rural upbringing on the Alberta plains. One of eight children, Cardinal was the son of a game warden who, he says, "instilled in me a great respect for nature, and the importance of living in harmony with the land. When I became an architect, I wanted to create buildings that were more compatible with the natural environment—and the nature of man—than the demeaning boxes that most people are forced to live in and work in."

Cardinal's radical notions of what a building should look like have not always been well received. Although he graduated with honors from the University of Texas at Austin in 1963, a decade earlier he had initially enrolled at the University of British Columbia School of Architecture. The prestigious Canadian school, however, asked him to leave after a single year, ostensibly because his predilection for voluptuous, curvilinear forms didn't mesh with a curriculum rooted in the rectilinear logic of Walter Gropius and Ludwig Mies van der Rohe.

Cardinal remains committed to his belief that the best architecture is modeled on forms found in the natural world—a realm where precisely executed rectangles are in notably short supply. Just off the Mall in Washington, in the suite of offices where the design for the NMAI is coalescing, the walls above the architects' worktables are hung with photographs of waterfalls, sandstone canyons, ancient petroglyphs, rugged alpine escarpments, Anasazi cliff dwellings, Haida totem poles, Navajo rugs. When Cardinal and his design team seek inspiration, it is to these images of the timeless and the sublime that they turn. Indeed, studying the most current model of the museum, rendered in 1:100 scale, it is obvious what Cardinal means when he calls the building "an abstraction of natural rock outcroppings."

"My team and I designed the museum from the inside out," Cardinal explains, "until a shape evolved that began to fulfill the building's fundamental requirements. We took that basic form and placed it on the site, working with the design until it fit in with the surrounding environment: the topography, the prevailing winds, the relationship to the sun." Cardinal's team paid particular attention to the museum's orientation to the axes of the summer and winter solstices, and other celestial points of reference, which have tremendous significance in the cosmology of many Indian cultures.

The museum began as a sketch rendered by hand, but the architect's pens and pencils were quickly supplanted by the most sophisticated computer technology available. Two decades ago Cardinal helped pioneer the use of computer-aided design, and he continues to rely on it to an enormous degree. "It would be pretty damn hard to design a building like the Space & Science Centre or the Canadian Museum of Civilization or the NMAI without it," Cardinal argues, "maybe even impossible. Before computers we had to rely on hand-calculated coordinates and descriptive geometry, and for the type of buildings I design it was just exhausting. Now the com-

Jon Krakauer wrote about Gates of the Arctic National Park in June 1995; his book Into the Wild *was published this year by Villard.*

puter will automatically dimension everything in 3-D, which allows complicated organic buildings to be competitive—in terms of design and construction costs—with ordinary boxes."

There are some design problems, however, that even the most powerful computers can do nothing to solve. Cardinal has had to confront an abundance of such conundrums in the NMAI, which, he acknowledges, "is the most challenging project I've undertaken to date." The crux of the matter, he explains, is that there are so many different clients who must be satisfied and disparate interests that must be reconciled: the United States Congress, the Smithsonian Institution, various bodies concerned with preserving the architectural integrity of the capital and the Mall, the American public, Indians across North and South America.

"Simply satisfying the Indians is a huge challenge in its own right," Cardinal observes, "because Indian people are so different, and we love to emphasize our differences. Furthermore, given the way they have been treated in the past, most Indians are very suspicious of anything having to do with Washington or museums."

W. Richard West jr., the director of the NMAI, does not deny that Cardinal faces formidable obstacles, but he has no doubt that the architect will prevail. "Among the fine architects who sought this commission," West explains, "Cardinal was selected for several compelling reasons. He was a Native architect of international repute. His organic approach seemed especially well suited to a museum concerned with Native art forms. Equally important, the selection committee was confident that he could deal with the immense challenge of building this particular museum in this particular setting."

For an architect of such iconoclastic reputation, Cardinal has had an uncanny ability to please the staid public agencies for whom he has so often worked. This architectural renegade in fact turns out to be a gifted conciliator and diplomat, a brilliant manager of people.

Pondering the Canadian Museum of Civilization, architecture critic Grant Gustafson has written that what Cardinal accomplished in Quebec "is even more impressive when one considers that the client was an octopus of fifty government departments; and that thirty subconsultants participated in the design; that the construction schedule was 'fast-tracked'; and that two hundred subcontractors simultaneously built it. Riding herd over such a daunting bureaucratic organism seems impossible, yet Cardinal managed to produce a magnum opus of great spirit and dynamism."

Now, as the millennium draws near, hopes are running high that Cardinal will accomplish no less in the American capital.

Backlighted by the moon, the baptistery of St. Mary's Church in Red Deer, Alberta, rises like a natural rock formation. Arches, free-flowing curves and circles make up the essential lexicon of Cardinal's oeuvre.

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By Elizabeth Royte

'Let the bones talk' is the watchword for scientist-sleuths

When the FBI moved in across the street 60 years ago, Smithsonian anthropologists began a tradition of helping to solve crimes

Douglas Ubelaker uses a stereozoom microscope to study bones that will become evidence in a criminal case.

It is late on a Thursday afternoon before Douglas Owsley can turn his attention to the cardboard box on his office floor. He shoves it toward a table and casually lifts the lid. He reaches into wrinkled white sheets and a blanket and pulls out a waxy brown skull.

Bone by bone, Owsley transfers the skeleton to his examination table. "Heavy brow, large mastoid processes, well-defined nuchal [nape of the neck] area," he murmurs, turning the skull this way and that. "Narrow nasal width, pronounced nasal spine. Definitely white, definitely male." But it doesn't take a physical anthropologist to deduce this much information. A medical examiner had supplied the man's identity. What the local pathologist wants Owsley to determine is whether this man, who had disappeared from a nursing home, had suffered any kind of trauma. The bones had been found in a wooded area near the home. It appeared that the gentleman had simply wandered off. Or had he?

Douglas Owsley works as a forensic anthropologist at the Smithsonian's National Museum of Natural History. Strong, compact and encircled by a tooled Western belt, he's the kind of person who doesn't hesitate to get down onto his bare office floor, if that's where the next box of bones lies. His scholarly work involves prehistoric and pioneer bones in the Great Plains and more recent bones in the East. But he also does forensic work. Police departments and medical examiners across the country routinely enlist Owsley's services. They come upon bones and want to know: Who is it? What happened? A forensic pathologist—in the mode of television's Quincy—asks similar questions, but Owsley's work picks up where Quincy's leaves off.

Most of his cases originate in rural areas, because bodies that come to rest in cities are usually found before soft tissues rot away. Dogs discover a fair number of bodies. So do hunters, in the woods after the leaves have dropped, and drivers, in any season, who stop to relieve themselves in wooded sites along roadways.

Owsley works in a cluttered suite of offices on the third floor of the museum. Scientific journals line his shelves, photographs of his buddies exhuming graves hang on the walls. Outside his door, the corridors are institutionally lighted and lined with drawer after wooden drawer, stacked 14 feet high. Here the skeletons of 30,000 people are carefully arranged and catalogued. The bones—of people ranging in age from prenatal to 90, who died between 10,000 years ago and one—hail from as far as Ecuador and Iraq, and as near as Bethesda, Maryland.

A forensic investigation usually begins with the opening of a package. Sometimes Owsley can resolve a case without even sitting down.

Police officer: Is this bone human?

Owsley: No, it's pig.

Officer: Thank you, goodbye.

Red straws in this lab skeleton indicate the paths of bullets, as reconstructed from bone damage.

Photographs by Robert C. Burke

More often, the inquiry will take weeks or months to play out. Owsley recently finished the case of a Baltimore police officer who denied any involvement in the slaying of his girlfriend. But investigators vacuumed up tiny bone chips—about the size of pencil points—from the back floor of his pickup. Owsley examined the chips under a stereozoom microscope and determined they belonged to somebody whose skull became fragmented perimortem—at or around the time of death. He found traces of soot, lead and blood on the fragments, features consistent, as they say, with those of a bullet fired at close range. "But it's the tiny traces of blood on the bone chips that helped nail him," Owsley says. "It shows up as red rust stains under the microscope." The officer was eventually sentenced to life plus 20 years.

Meanwhile, Nursing Home Man lies on the table, his hand bones in one pile, his foot bones in another. Owsley sorts through the ribs, arranging 12 on the right and 11 on the left. "Hmmm," he says, not overly concerned. Then he picks up a short bone—"rabbit," he says—and sets it aside. It's not unusual to find animal bones with human: the dog that finds bones and buries them under the back porch is not discriminating.

Owsley starts to calculate the man's height, based on the length of his leg and arm bones. He looks at the points where muscles were attached to bone, to get an idea of his build. A creative forensic anthropologist may look at, for example, the ridges where muscles attach on finger bones and wonder if this unidentified skeleton once played the flute, but he'd never include such speculation in a final report. "The science on that is a little flaky," says Douglas Ubelaker, who, as the other forensic anthropologist at the museum, works about 40 law-enforcement cases a year. (He also teaches at George Washington University.) "It could lead investigators to look for missing flute players and rule out all others."

Ubelaker and Owsley are both infuriatingly cautious. "Let the bones talk to you" is their motto. Scientists to the core, they make conclusions based solely on the evidence at hand. "You can't go on your gut feelings," says Ubelaker, sober, mustachioed and, on a summer day when the air conditioning is not working, dressed in sandals, a blue polo shirt and pleated slacks. "A prosecutor comes in, he's convinced it's this guy, and he says, 'Doc, what do you think?' There's a subtle pressure to support his opinion. But you must divorce yourself from that. I'm not an advocate for the FBI or the defense but a spokesman for the victim." I ask if he's ever been wrong. "I don't recall ever being very wrong in a forensic case, considering the evidence available at the

Douglas Owsley stands inside exhibit on 17th-century chapel in St. Mary's City, Maryland. He is studying remains of early Colonists, including skeleton opposite.

time." Though he sounds smug, he is not. He is stating a fact. "You shouldn't be wrong on a report. I won't say it's the skeleton of a person 37 years old, but I will say with 90 percent certainty he's between 30 and 38."

Sixty years ago, the use of anthropology to solve crimes was virtually unheard of. The law-enforcement community didn't recognize that skeletons contained clues that were inaccessible through conventional forensic examinations, and anthropologists, for their part, were reluctant to get involved in police work. Applied science—using anthropology to achieve an immediately tangible result—was somehow less pure than basic research, went the thinking.

Today, forensic anthropology is an accepted science. The American Board of Forensic Anthropology certifies new diplomates each year (Ubelaker is the current president). At the Smithsonian, forensic anthropology began in the 1930s when the Federal Bureau of Investigation moved in across the street on Constitution Avenue. Ales Hrdlicka, director of the Division of Physical Anthropology from 1903 until 1943, formalized the relationship, and in 1942 Hrdlicka's student and successor, T. Dale Stewart, began to consult regularly for the FBI. In the 1950s Stewart helped in the identification of Korean War dead. But it was the bow-tied, cigar smoking Larry Angel (SMITHSONIAN, February 1977), who worked so many cases in the 1970s that the press started calling him "Sherlock Bones."

(Other Smithsonian scientists also are taking on forensic missions. Roxie Laybourne, an ornithologist [March 1982], has taught several graduate students about identifying feathers found at plane crashes and murder scenes. And there are practitioners of forensic geology and entomology. Geologists can often tell from dirt particles in a victim's clothing where a murder actually happened. Entomologists can tell by what insects are present on a body how long the person has been dead.)

Even now it's not all smooth sailing within the scientific community. "Some anthropologists still think it's technical, not research oriented," says Owsley, heatedly, "but it *is* research oriented! The information we derive immeasurably improves our work on older skeletons. We look at Civil War digs, at whites versus blacks, old versus young, urban versus rural, rich versus poor, and we see changes in health trends. We can follow health trends through time. We see the results not only of bone cancer, but breast cancer, which metastisizes and perforates bone. We can now track the evolution of warfare among Plains Indians for 6,000 years by bone pathology."

Owsley and Ubelaker enjoy their law-enforcement cases but they both favor historical work—Owsley studying the bones of Colonial villagers and Native Americans, Ubelaker working in Ecuador and in museum collections in Europe, tracing the history of diseases. In studying ancient bones, physical anthropologists are less interested in individuals—how a man fractured his pelvis and why he was buried with his dog—than in documenting what happened to communities over time and space: what they ate, how and where they lived, what diseases afflicted them, how their life expectancy changed as they abandoned the nomadic life for agriculture.

Says Owsley, "We apply what we learn from archaeological excavations to criminal cases, and vice versa. The information flows both ways." Owsley's work with the victims of a prehistoric war who had been dismembered immediately after death proved to be invaluable experience when he worked on the case involving Jeffrey Dahmer's first victim. He analyzed hundreds of bone and tooth fragments that Dahmer had crushed with a heavy implement and scattered over a two-acre site, examined each for cut marks and determined the age and sex of the victim. The Smithsonian's Ralph Chapman clinched the identification by digitizing bitewing x-rays taken by a dentist so they could be scaled to match images from the remains. A second molar root was identical to a 90 percent probability.

Elizabeth Royte lives in New York City. She writes about the natural world for Outside, *the* New York Times Magazine, Harpers *and other periodicals.*

Karin Sandness

This skull was struck 19 times with the head and claw of a hammer; most of the damage is in back.

Douglas Owsley grew up in a small Wyoming town, the son of a fish and game warden. He entered the University of Wyoming as a zoology major, planning on a career in medicine, or perhaps dentistry. That changed when he volunteered one summer to help George Gill, a charismatic anthropology professor, work a thousand-year-old burial site in Mexico. They mucked around mangrove swamps all day and ate huge shrimp cocktails at night. "I said to myself, 'This is the life,'" recalls Owsley, grinning. "I got completely caught up in it." He switched his major, earned his doctorate in physical anthropology under Gill at the University of Tennessee, then began teaching at Louisiana State University in 1980. The crime rate around Baton Rouge and the preponderance of bayous for dumping bodies meant plenty of hands-on forensic cases. In 1987 the Smithsonian sent out a call for a new physical anthropologist and Owsley applied. Today, Gill and Owsley continue their work together, most recently in the analysis of late prehistoric and historic period skeletons from Easter Island.

Douglas Ubelaker also slipped into anthropology after accepting, as a lark, a summer job on a dig. He was a premed student at the University of Kansas when an anthropology professor noted his muscles and invited him on a dig in the Dakotas. The keen-eyed professor was William Bass of the University of Tennessee, who has trained the majority of the forensic anthropologists in the country. To Ubelaker, the prospect of studying centuries-old remains held a "distinct element of romance." He, too, was instantly hooked, and by the end of the summer the Ubelakers knew there would not be another doctor in the family.

Drafted in 1968, just after graduating from college, Ubelaker was assigned to a military hospital lab in Washington, D.C. He spent his spare time working in the Smithsonian's collections, incidentally forging the alliances that would secure him a job at the museum after he earned his doctorate in Kansas.

Both Ubelaker and Owsley appreciate the mystery in their law-enforcement cases, but they try not to get too involved: the bones come and go, and often they don't find out what becomes of a case once their role—pinpointing the age of a bone's owner or suggesting a probable murder weapon—is finished. Knowing a victim's vocation and personal habits could prejudice their investigations. Working on decomposing bodies at the Branch Davidian compound in Waco, Texas, Ubelaker didn't want to know which cult members were still unaccounted for. Along with FBI agents, Texas Rangers and staff from the medical examiner's office, he sorted through hundreds of bones, which they first had to excavate from under the rubble and unexploded ordnance. He and Owsley were part of the team that then listed probable ages and sexes and matched what they could with skeletal x-rays. Keeping their minds open to any and all possibilities was essential.

Such work affects a forensic anthropologist's personal life. Investigations and testifying at trials mean time away from home. Even at home the work intrudes. At Ubelaker's Christmas tree farm in Virginia, he pokes scraps of plastic and other compounds into fires, just to see how they'll emerge. Burned drywall, it turns out, can resemble bone. So can garden hose.

"You do develop a special interest in tire irons," he adds. "I can't go into an auto supply store without evaluating the differences between them."

Promoting accuracy in mysteries

Sometimes, fiction overtakes fact in the museum's anthropology department. Best-selling crime novelist Patricia Cornwell consulted with Ubelaker as she worked on *All That Remains*, about a serial killer in Virginia. Cornwell spent a day with Ubelaker, looking at slides of damaged bones and trying to figure out what cut marks on a hand phalanx, a finger bone, would look like. "I asked him what a serrated knife would do," Cornwell says. "Doug told me that with a slice it's impossible to tell, because the points of the blade would cover their own tracks. Only if the bone was hacked could you tell." In her book, the heroine—Kay Scarpetta, a medical examiner—is able to determine that a bone has been hacked, a wound incurred when the victim tried to defend herself. And Ubelaker was the inspiration for the character

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The knife was twisted, or the young woman victim moved as she was stabbed, splitting this section of a rib.

Dr. Alex Vessey, the Smithsonian's expert bone man.

Nursing Home Man, after several hours on the table, smells warm and mammally. His bones feel greasy, which isn't unpleasant, but they're also flecked with bits of dried tissue and a waxy, light brown substance—adipocere, a byproduct of fat decomposition in moist conditions. Owsley isn't wearing gloves, so I make up my mind to be brave, as well. In grad school, Owsley was assigned to work on an extremely fat woman who was found dead and in an advanced state of decomposition in the Smoky Mountains. Her body, says Owsley, was actually foaming with adipocere, and the odor was intense. "I worked for ten minutes, threw up for ten minutes, worked for ten minutes, threw up for ten." And then he never threw up again.

Owsley now looks for any "inclusions" in the cardboard box—bullets, rings, documents, a shoe. Save for the rabbit bone, the box contains only human parts. He notes taphonomic evidence, that is, any changes that affected the body after death. Such evidence may include vegetation that grew on a body as it lay under a porch, silt that settled in bone cracks when the skeleton was later dragged toward a river, a snail shell that lodged between vertebrae as the spine drifted downstream. "One of the great things about the Smithsonian," says Owsley, "is that I can pick up the phone and call a botanist to analyze the algae, a geologist for the silt and an invertebrate zoologist for the snail. Forensic anthropology combines a lot of disciplines."

Owsley holds a femur in the air. "See that lipping [bony extensions] on the end? Arthritis," he says. I pick up a fingernail from among pelvic bones and move it up to the hand pile. It's long and yellowed and thick, and it gives me more of the creeps than anything else arrayed on the table, even the equine-looking teeth.

As Owsley examines the ribs, I open a yellow envelope that came with the box. It's full of hair. "Hey," I say. "This hair is kind of dark." Owsley stops and looks over.

"No gray?"

"No, and there's plenty of it—for an old guy."

"Well," he says, "he wasn't really an old guy." The plot thickens; Owsley knows more than he is letting on. He continues, "Actually, this guy was 45." I nod, "His wife put him in the nursing home because of his diminishing mental capabilities. They suspect she was poisoning him, perhaps even while he was in the nursing home."

Now I know that we aren't looking at an elderly man with Alzheimer's who'd wandered away, gotten lost in the woods and died of a heart attack, exposure or starvation. The bones, come to think of it, do look pretty strong, despite the arthritis. Owsley tells me that toxicologists will be working up his bone marrow, looking for evidence of poisoning. Still, he's got to examine each bone for signs of trauma. Had the dead man been in a fistfight? The nose does not appear broken. The hyoid, a fragile bone in the throat, is intact, but strangulation can't be ruled out. Had he battled an attacker? The ulna—one of the forearm bones, a common spot for a parry fracture—shows no sign of trauma. Nor do the ribs, all 23 of them. Without a major bullet hole to offer immediate gratification, I can imagine this inventory becoming tedious. But Owsley doesn't let up. "You have to go all out on each case," he says. "Each person is equally important. Someone cared about him."

Sometimes, the person who cares doesn't get satisfaction for a long, long time. In January of 1978, in a small Midwestern town, the trailer home of a family named Morris caught fire. Mrs. Morris reported that there had been an explosion and that her husband had rescued her 6-year-old son from the flames, and a neighbor had rescued her 9-year-old. Her husband, Donald Morris, she said, threw her out of the trailer, then attempted to rescue her 5-year-old. But the two never made it out. The fire chief, brand-new on the job, ruled out arson. The medical examiner declared the deaths accidental and did not perform autopsies.

Morris' brother, however, told the chief of detectives that the entire case smelled fishy to him. Dan D'Annunzio, the newest detective on the staff, was assigned to the case. D'Annunzio brought in one arson investigator who said the fire had been set. A second expert concurred. D'Annunzio asked to have the bodies exhumed, but the medical examiner refused.

For the next 15 years D'Annunzio worked on the case whenever time allowed. In 1993 he thought he had enough to reopen the case. The county attorney told him that if he could come up with one more piece of evidence, he would do it. D'Annunzio then found the older son in a prison. The son told him that he had woken that winter night and seen his mother hit his

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stepfather over the head with an ashtray and then stab him repeatedly in the back as he lay on the floor.

From a high shelf in the hall, Owsley retrieves Donald Morris, neatly arranged among crisp white sheets in a large cardboard box. Owsley sits cross-legged on the floor and takes out the bones. Morris' skull is badly burned, covered with dry patches of black and white that resemble lichen. Owsley holds up a femur. "This case really talks to you. Look at how strong he was—you can see where the hamstrings were attached. Powerful man; you can just imagine him throwing his wife out the window." "Now look at this vertebra." He holds up another one. "See the cut mark?" I do: there's an angular end on the transverse process (an extension to the side) of this lumbar vertebra. I can see the sharp cuts of a knife or machete. Owsley shows me several ribs with the same markings, clear evidence of multiple stab wounds.

"This skeleton says *so* much," Owsley says, again. He's excited now, remembering the case, holding up bones left and right. "Look at the pelvis—it was cracked and then healed. Look at the nose, it's been broken. When I met Morris' brother in the courtroom, he said, 'It's just like Donald is here—you know so much about him.'" Partly on the basis of Owsley's work, a jury convicted Mrs. Morris of two counts of murder and one of arson.

Precisely because Morris' skeleton was so expressive, Owsley asked the family if the Smithsonian could have it for its collections, to use for teaching. They agreed.

That case was closed. Nursing Home Man was proving more intractable. Owsley finished examining the remains. He found no evidence of trauma, and the toxicologists found not a trace of poison in his bone marrow. The man's wife may have committed the perfect crime, but it's still too soon to tell. Owsley has started on another dozen cases—an unidentified skeleton from Northern Virginia, a young girl with cut marks on her cervical vertebrae—but he hasn't closed the book on Nursing Home Man quite yet. He's got a more powerful microscope down the hall, and he plans to look at each of the 205 bones once again.

Karen Oeh, a graduate student at California State University, Chico, compares a gunshot victim's x-rays and bones. Each year Owsley trains several students, part of the next generation of forensic anthropologists.

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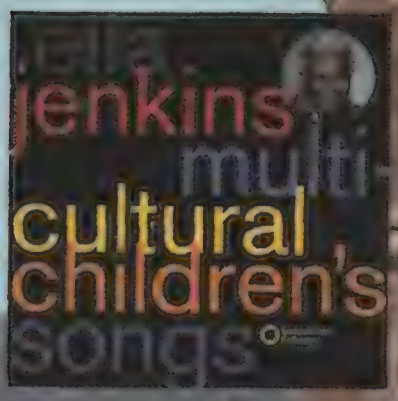

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By Carol Simons

For these precious scrolls, aged glue and 'damage maps'

Not to mention patience, as 40 of them go from the Freer Gallery to six workshops in Japan to undergo a complete overhaul

Fresh from restoration in Japan, an 18th-century scroll (opposite) hangs in a show at the Freer; in Kyoto (above), other scrolls are still under the knife.

Her powerful magnifying glass almost brushing the ancient scroll, Kyoko Tominaga wielded her scalpel-like knife with the delicacy of a surgeon, gently trimming a silk patch no larger than a crumb. Then another crumb. And another. And another. With a puff she blew away a smidgen of silken dust and began again.

Three hours later, the 30-year-old woman unclipped the magnifier that protruded from her glasses, rolled her shoulders and broke for lunch. In the morning's work she had patched two inches of the elephant's leg on the Fugen (a depiction of a bodhisattva, or compassionate being, riding an elephant). The 14th-century Japanese scroll painting is owned by the Smithsonian's Freer Gallery of Art.

Tominaga and three of her colleagues at the Oka Bokkodo studio in Kyoto were steeped in day 14 of a six-week odyssey across the surface of the 8-by-3-foot Fugen, filling in the thousands of tiny holes that had marred the priceless 600-year-old work of art. "You have to be really patient to do this kind of work," said Tominaga with obvious understatement. "It takes a lot of time."

The Fugen is one of 40 of the Freer's 662 Japanese scroll paintings selected to be rejuvenated under an art restoration project, initiated in 1991, to preserve pieces of Japan's cultural heritage held by museums around the world. The initial phase is being carried out in collaboration with the Freer and supported by Japanese government agencies and a private art foundation headed by Japanese artist and scholar Ikuo Hirayama.

As well-intended as the project may be, need outstrips resources. "Unfortunately, it's a triage process," says James T. Ulak, associate curator of Japanese art at the Freer and Sackler galleries. "We'd like to restore all, but resources are limited so we have to evaluate each painting and the degree of need." The 40 neediest, which date from the 12th to the 20th century, have all made the trip to the six workshops participating in the project—four in Kyoto and two in Tokyo. Most have already returned home and are on display in the current Freer exhibition "The Life of a Japanese Painting," which runs through September 29. Organized by Ann Yonemura, associate curator of Japanese art, it documents the difficult process of restoring and mounting a scroll.

The four workshops in Kyoto are located in the same brick building at the Kyoto National Museum, but despite proximity and shared interests, rivalry makes neighborly drop-ins rare. A visitor to one studio peeks into the doorway of another and is politely admonished: "You can't do that. You haven't made an appointment with them."

Such reserve is typical of Kyoto, where cultural elitism is a way of life, especially in the art world. "If Kyoto people meet you casually in the street and invite you for a

At the busy Oka studio in Kyoto, some artisans apply silk patches to damaged areas of a scroll while others concentrate on removing old lining paper, toning silk patches and preparing backing paper for pasteup.

visit, you're considered very rude if you go," a Tokyo native said with a chuckle. Foreign curators, doctorates in hand, who regularly interact with the Japanese conservators tread delicately in order not to offend. Walking on eggshells is an essential skill.

To step into the Oka workshop is to enter a curious world spanning centuries. Fat Edo-style brushes line the walls near a high-tech photograph taken by an infrared camera. A small Shinto shrine, to protect the studio from fire, is tucked into a corner above a sink and a two-burner hot plate. Wooden drying boards, the same kind as those used hundreds of years ago, hold scrolls being repaired with silk patches that have been artificially aged at the Takasaki radiation laboratory 200 miles to the east.

Shelves near one end of the room are stacked with paulownia wood boxes, traditionally used to store scrolls, while air-conditioning keeps the workroom at a perfect temperature year-round. Wheat-starch paste, aged for ten years, is stored in a brown ceramic vat next to stainless-steel pressure pumps, for wetting down layers of *washi* paper used to back the scrolls.

A dozen artisans dressed in khakis or jeans sit cross-legged at low tables, all but lost in their tasks. They painstakingly cut, glue and shave tiny pieces of silk, using techniques and tools passed down through generations. One woman, her sweatshirt proclaiming "Champion Olis Boy in Bloom," the kind of nonsensical English young Japanese love, works on a 1,300-year-old scroll, patching tiny holes with paper aged for a dozen years. The nine-foot-long worktables, made of cypress wood, are themselves works of art, built to last a century, growing ever thinner as their surfaces are planed to keep them free of nicks and gouges. New ones can cost $40,000.

The studio is quiet save for the drumming of the *uchibake* as a restorer pounds and stretches wet paper with the heavy brush, its thick bristles handcrafted from palm-tree fibers, its price as much as $750. Others use 20th-century tools: light tables, x-ray, microscopes, infrared cameras, video cameras and computers.

"Today, we may mix the traditional with the new, but there's very little change in the basic way we do things," says Iwataro Oka, 53, whose grandfather founded the workshop in 1895. "Thirty years ago we didn't have all this equipment and we still managed to repair scrolls. We have x-ray and computers and other technology, but most of our tools are still from Edo times [c. 1600-1868]. So are most of our techniques. No matter what scrolls we're working on, the methods we use are pretty much the same."

A good example is the Freer's Fugen, which underwent rigorous restoration from the time it reached the Oka studio in June 1995 until it returned to Washington in April. It was, in the words of one restorer, "a mess," in a state of advanced deterioration, with thousands of holes and patches—and patches with holes—that had

been inexpertly applied in layers over hundreds of years. It was discolored by smoke, dirt, dust and just old age. The existing paper lining, added during the Edo era, was black and visible through the translucent silk, making it impossible to see the image of the bodhisattva on an elephant surrounded by attendants. Also, the Fugen, like many of the Freer's scrolls, had been affixed to a wood framework rather than being kept rolled up in a box and taken out for brief showings. This basic sin against the intended treatment of scrolls left the fragile painting exposed to atmospheric hazards.

For the first two months, conservators and technicians studied the Fugen, plotting a course of action. They produced dozens of detailed photographs plus a life-size black-and-white "damage map," marked in orange to show the areas requiring repair. An infrared photograph revealed a mosaic of tiny patches that had to be removed. An x-ray, resembling any chest x-ray at the doctor's office, revealed the composition and density of the paint and allowed the artisans to look inside layers to see, for example, whether a line on a robe was altered from the original. A microscope showed the type of weaving. Video cameras and computers produced records for the future. "We use this equipment like a doctor does, to study before we operate," Oka says. "Then we can fix the problems and try to preserve the original, to make it one smooth piece of silk."

At the end of November, hands-on work began on the Fugen. The painting was separated from its blue border and wood framework, and lightly sprayed with water and blotted with special absorbent paper for cleaning. Then began the most critical step: removing the black lining, and the old patches and their linings, from the back of the painting without doing further damage. A thin paper facing was temporarily applied to the front with a weak seaweed-based gel (so it could be readily removed later) to hold the painting in place. Then, the scroll was reversed on the table and the lining removed. This alone took five weeks.

The process involved moistening postage-stamp-size areas with a brush and using the gentlest of tools—cotton swabs, tiny tweezers, fingertips—to pick the lining and old patches away. The translucent silk turned out to be painted on both sides, the stronger colors on the back, the detail on the front, a subtle technique used in the finest scroll paintings to produce a three-dimensional effect. Free, the painting was reduced to its purest and most fragile state, thinner than a woman's stocking, the elephant-riding bodhisattva seeming to float in air.

This was when Kyoko Tominaga and her three colleagues moved in with their scalpels to begin the transformation of the Fugen into a smooth, silken jigsaw puzzle. Eight to ten hours a day, they worked with unwavering concentration, their heads nearly touching inches above the priceless scroll. They replaced any damage,

Iwataro Oka, head of Oka studio, and conservator Tokuichi Taguro select border silk for a Freer scroll.

At Usami studio, Connecticut-born apprentice Andrew Hare affixes paper with aged paste to back of scroll.

Seated cross-legged at a light table, a worker, using fine tweezers, removes old silk patches from a painting.

or "loss," larger than 0.5 millimeters with a new patch of beige silk artificially aged by radiation so that it structurally matched the original.

"It's important that patches and the original silk be similar in strength," explains Oka. "If you patch a scroll with a piece that is stronger, it will create stress on the old. This is what many restorers used to do, and instead of being preserved, the scroll got worse over time." The effect of radiation is easy to see when Oka holds two pieces of beige silk in his hands, one fresh and one exposed to electron beams. He rubs the latter lightly between two fingers and the weave immediately begins to come apart.

By the end of February, the Fugen was a smooth silken sheet, its new patches pasted in place and ready to be unobtrusively blended with the original. The question was, what color to apply to each patch? One restoration technique is to re-create a piece of the image on the new patch, a practice that many experts consider dubious. According to Oka, "this is something the Freer doesn't accept." Another technique is "overpainting," painting on the original silk to replace what has badly faded. This is forbidden in today's restoring world. In general, the Freer's policy, and that of many top museums, is not to re-create, not to add lines at all.

The accepted practice is known as toning, camouflaging the gap by subtly coloring the silk infill to a "common denominator," usually tan or brown—the shade to which silk ages due to dirt, smoke or temperature—so the repair is barely noticeable. Many experts believe proper toning has the least jarring impact on the final work; that it's best to leave the lost areas of a picture lost.

Patched and toned, the Fugen was ready for the first of its many new linings, the *hadaura*. This time the lining was not black, but beige, chosen to best show off the image. With the paper facing still shielding the front, the hadaura was applied to the back with wheat-starch paste, which allows the scroll to be flexible for rolling (and also makes possible the removal of the lining, if necessary, 100 years from now). The hadaura was followed by four or five more linings added for strength.

Next came the Fugen's fabric border—gold brocade with peonies. The format, the size of the border, the colors, how the pieces were applied, followed the style suited for a Buddhist subject, the brocade historically, iconographically and esthetically correct. (Scrolls with secular subjects, such as women and children, follow another format and use other fabrics.) An overall lining and a final backing were applied before workers "folded the ears" to form a hem.

The border and all these linings and mountings are often compared to a Western frame, in that they add beauty and also support and protect the painting. But according to Freer curator Ulak, the comparison is only a starting point. "The Western concept nowhere approaches the Japanese concept of the work as an organic whole," he explains. "A Japanese painting is more than lines and images; the mounting and painting are one. You can kill a painting with a bad mounting. The border may be wrong or the choice of backing color, which shows through the silk, can be wrong and ruin the image."

The Fugen spent March drying. Completion finally came when the accouterments—upper hanging rod, lower roller, decorative strips and tying cords—were attached. The scroll was rolled from bottom to top and laid to rest in its custom-built storage box of paulownia wood. In April the restored Fugen returned home.

The restoration of the Fugen symbolizes Japan's response to a basic question: Whose responsibility is it to

A damage map is made for each scroll: problem areas are marked in orange on a black-and-white photograph.

A recent returnee to America after 14 years in Japan, Carol Simons has written about Japanese plastic display food and "education mothers" for SMITHSONIAN.

After restoration, the Buddhist sage is defined by the original pigment; color of the first lining blends in.

preserve art objects originating in one culture and owned by another? Ikuo Hirayama, a former president of Tokyo University of Fine Arts and Music, a noted contemporary painter and the driving force behind the project, believes that art, no matter where it resides, is the world's heritage and requires the world's cooperation. He also believes that Japan's postwar prosperity obliges the nation to support this kind of cultural cooperation. "As for Japanese art objects," he says, "no matter what country holds them now, their original home is Japan."

Because the scroll is one of the world's most fragile art forms, many scrolls—in Japan as well as abroad—are in a sorry state, for a number of reasons: inept handling, clumsy restoration, exposure to harmful levels of temperature, humidity and light, the work of insects and other environmental factors. Silk, an animal fiber, has a protein structure that gradually deteriorates. Earth pigments and glues are relatively stable, but once they are applied to paper or silk, the glue begins to break down, eventually leaving the pigment affixed delicately to the surface. This contrasts with Western oil paintings, in which layers of pigment are suspended in oil and further protected by varnish.

Storage presents its own problems. Traditionally, Japanese collectors followed the "inspect and air" practice—taking their scrolls out of storage just after the rainy season and unrolling them for airing, then returning them to their fitted boxes. A tenth-century code of regulations, the *Engishiki*, prescribed the exact process and time, making Japan possibly the only country in the world with government rules on caring for art objects.

Six years' work and a $3 million tab

After World War II, the government engaged family studios like Oka's to help restore works designated as Important Cultural Properties. The demands for superior workmanship and knowledge became paramount, and those involved were elevated from craftsmen to the loftier realm of conservators. Restoration is also big business. The restoration of one extraordinary piece from a temple in Nara, more than 350 feet long, is taking six years to complete at a cost of $3 million.

Naohachi Usami, 70, is the first president of the Association for the Conservation of National Treasures, which includes seven workshops and 120 members. His studio in Kyoto, Usami Shokakudo, is more than 200 years old. The eighth generation in the family business, he hopes his two sons and grandson will carry on.

While the old pattern of family studios has largely broken down, the apprenticeship system remains. Young people start at around age 22, although, according to the philosophical Usami, "it was better in the old days, when they started at 14 or 15." A typical studio has 15 to 30 workers, some from families of weavers or artisans, others who have acquired their own interest in art or art history. A few are college educated. As recently as ten years ago, few women worked in these studios. Now, at Usami's studio, they're a third of the staff. Apprentices start with minor jobs, such as making paste, and graduate through the various restoration and mounting processes. "It takes 10 years to learn techniques," Usami says, "20 to become a skilled master." Most scrolls take months to repair; Usami's personal best is 26 years on a hand-scroll comprising 4,331 Buddhist sutras.

Usami and Oka hope to involve more foreigners in their projects and say it's important to spread the skills of Japanese preservation techniques. "We have to open up the mystique of Japanese culture," says Oka.

James Ulak is on the same bandwagon. He hopes that the art restoration project with Japan will lead to a conservation center in this country, perhaps at the Freer.

(Although the Freer has had a studio since 1924 that restores East Asian paintings, it is staffed by only three specialists—two trained in Japan and one in China.) As important as the restoration work itself, he says, is the relationship the project has fostered between government agencies, museums, studios and individuals in many countries. "This is not just a quick repair job, thank you and goodbye," he explains. "We're looking forward to the long term."

Ideally, a center in the United States would become a conduit to help train young Americans in the conservation and restoration of Asian art. "There are very few qualified Americans or Europeans heading up studios in the West," Ulak says, "and also very few who can do restoration work." One of them is 33-year-old Andrew Hare, a native of Milford, Connecticut, and an apprentice to Usami for the past six years. A longtime student of Asian culture, including the tea ceremony and bonsai, Hare blends easily into the studio's environment. Tall and serene, with a neatly trimmed beard, he walks respectfully behind his *sensei*, or teacher. Hare helped translate the 344-page book on the project, *Restoration of Japanese Art in European and American Collections.*

Hare enthuses about Kyoto's art scene over a beer and snacks, fried lotus root stuffed with hot mustard, in one of the tiny bars that speckle Kyoto's famed entertainment district. "We just had a paper conference here," he says. "Everyone was talking about fibers and water content—it was terrific."

After graduating in Asian studies from Oberlin College, Hare settled in Kyoto because the training he sought was not available in the United States. "For a full apprenticeship, I had to go to Asia," he explains. This meant starting with the basics: cleaning floors, stirring paste for hours on end, prepping everything for the experts. "That's the way you learn," he says. "Then they start giving you little projects on your own, but always with a lot of supervision. That's the way you improve."

Working on major projects like the Fugen takes "a certain mind-set," adds Hare. "The patching may seem tedious, but actually it can be soothing, sort of meditative. You get used to it. Just adjusting to bending your neck takes about two years."

Hare admits, though, that he sometimes gets "a little crazy" and "tired of hearing that everything is done perfectly in Japan or that things here are unique." Like others in the field, he believes that Americans and Europeans can and must learn to restore their own Asian works of art. "The Japanese obviously are masters," he says, "but we should strive to do this work as well."

Humans and animals mourn Buddha's entry into Nirvana in a restored scroll now on view at the Freer.

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By Douglas Stewart

Creatures wild and wonderful thrive at a living lab in Kenya

The Mpala Research Centre offers a pristine environment for collaborative study on how humans and wildlife can coexist in the future

My first glimpse of the new Mpala Research Centre, a five-hour jeep ride north of Nairobi, Kenya, is a strange one. A cluster of scientists are bunched like meerkats on a granite outcropping next to the entrance road, all of them peering excitedly toward a nearby ridge. I climb out of my mud-spattered Suzuki and quietly join the clump. Looking where they're looking, just below a rocky escarpment, I notice dozens of rust-brown boulders appearing and disappearing among the acacia trees. I realize they're a herd of wild elephants. I introduce myself sotto voce to Nick Georgiadis, the center's director, and ask how many elephants are in the group. "It's hard to say. At least 200."

Caked in mud, the animals are moseying up the side of the ridge a quarter-mile away, heading north. The

Reticulated giraffes flourish alongside lions, zebras, hippos and other megafauna on Mpala's 50,000 acres.

How vegetation responds to the grazing habits of wild animals and livestock is a major focus of research.

elephants move through the dry acacia scrub in an endless, lumbering procession. Their progress is intermittent: they stop periodically to wrap their trunks around tree branches, then rip the branches loose and tuck the brittle foliage into their mouths, thorns and all. The herd isn't following a trail; it's making its own as it goes.

Scientists who come to the Mpala Research Centre to study wildlife ecology don't have far to look. The new field station, opened in late 1994, is the Smithsonian's first permanent research facility in this part of the world. Its mission is twofold: to study looming threats to the dry savanna-bush habitats of sub-Saharan Africa and to help train the next generation of African scientists and environmental managers.

Both are tall orders, which is why the facility is relying on collaboration with other institutions. The center is a joint venture of the Smithsonian, Princeton University, the Kenya Wildlife Service, the National Museums of Kenya and the Mpala Research Trust, and each organization is involving researchers or students in its study of the workings of Mpala's ecosystems.

Coordinating the Smithsonian's role is the Smithsonian Tropical Research Institute (STRI), based in Panama. STRI's traditional focus has been tropical rain forest and marine ecology. Mpala's landscape, by contrast, is a mostly parched, inhospitable-seeming mixture of brittle grass and stunted-looking trees—anything but rain forest lush—yet its varied terrain supports an astonishing roster of "charismatic megafauna": not just elephants but lions, cheetahs, leopards, monkeys, giraffes, hippos, zebras, buffalo, warthogs and gazelles (of the large African mammals only rhinos are absent,

Photographs by Art Wolfe

due to poaching), as well as ostriches, eagles and cobras.

"No other Smithsonian field site has anything that even approaches this," says bird ecologist Jim Lynch of the Smithsonian Environmental Research Center in Edgewater, Maryland. Lynch predicts that Mpala will be a magnet for collaborative research. "Instead of having data for birds in South Africa, plant phenology in Tanzania, and mammals in the Sudan, researchers are doing studies in the same place at the same time. That's when you start to see what's connected to what."

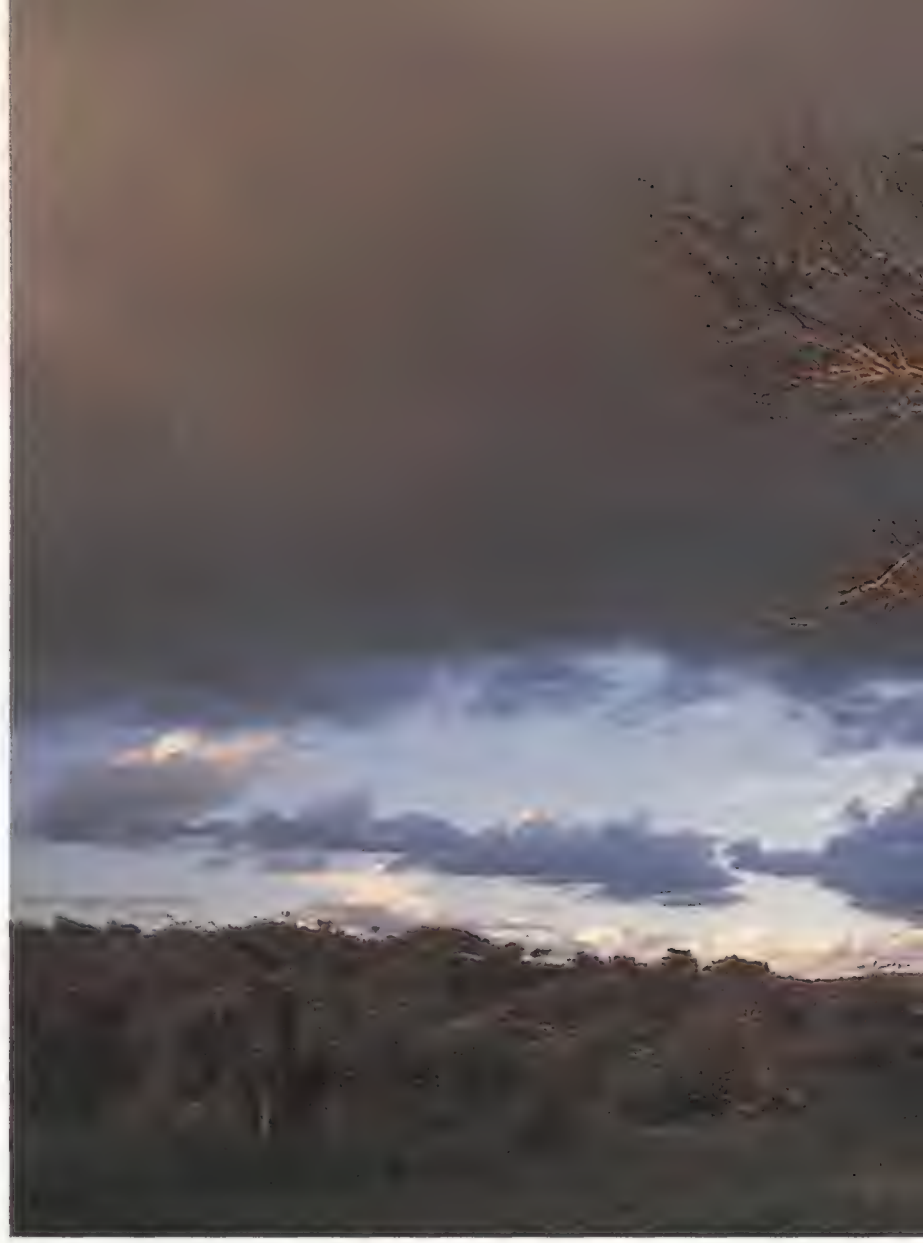
That the Smithsonian secured this foothold in Africa was a stroke of luck. In the late 1980s, George Small, a retired Baltimore food-industry executive, approached his alma mater, Princeton University, about turning over his 75-square-mile cattle ranch in Kenya to wildlife research. Princeton brought in the Smithsonian, and together they joined forces with Kenya's two chief wildlife authorities to administer the field station as partners. Small, an ardent conservationist who visits his Mpala Ranch frequently, serves as the operation's chairman and "principal visionary," according to Nick Georgiadis.

Small's ranch house is a simple, well-lived-in affair with overstuffed furniture, an English-style lawn, and trellises covered in orchids and bougainvillea. Hornbills perch in the trees, wild Egyptian geese waddle across the lawn and swallows dart in and out of the dark-paneled living room. Lanky and still athletic at 75, Small is a soft-spoken, self-effacing man. He inherited the ranch from his brother 27 years ago, but he still seems awestruck to find himself surrounded by wild animals. "We have a leopard that lives right behind the house here," he tells me, more in delight than anxiety, when I join him one morning for breakfast. "I think his tracks passed behind the house a couple of nights ago."

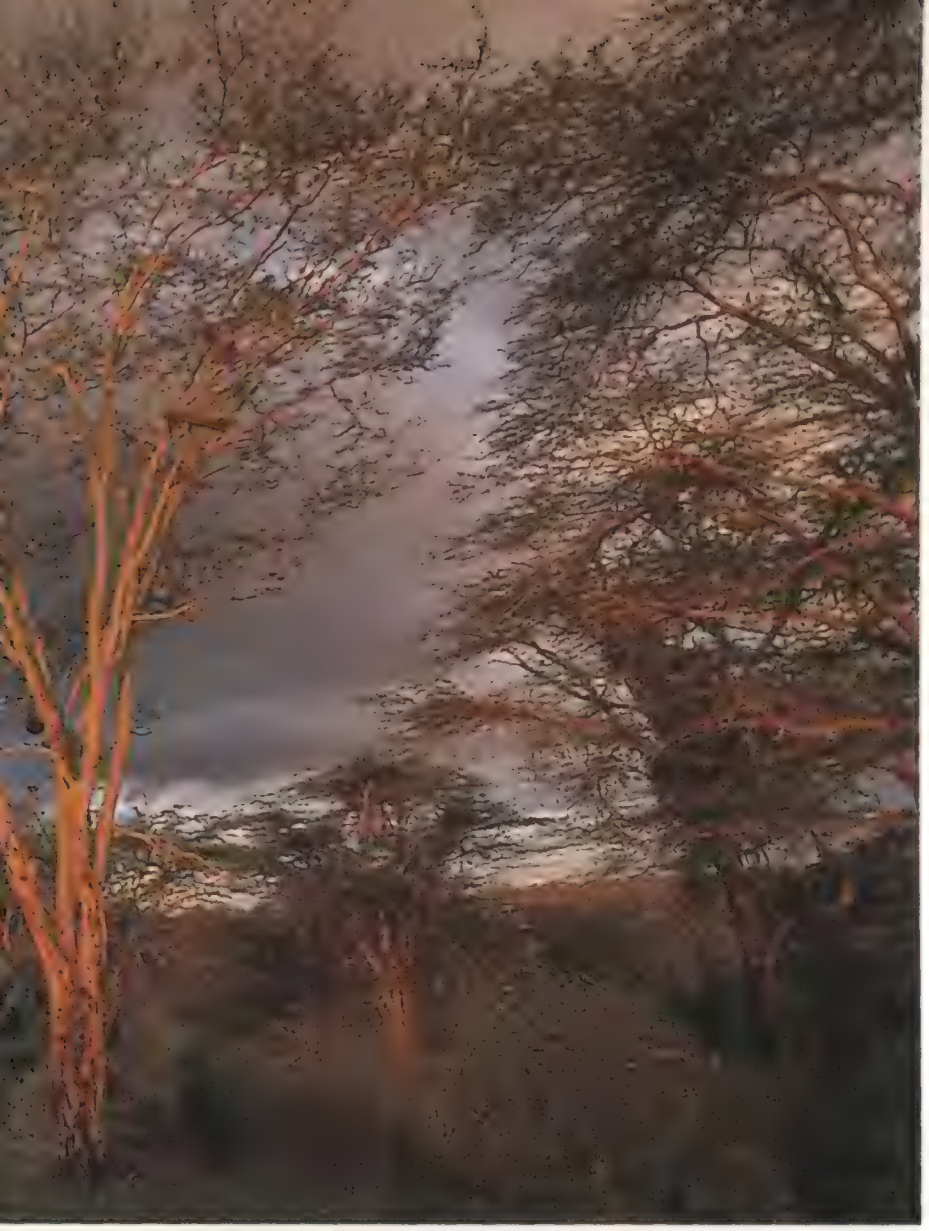
Eager to show me the ranch and its fauna, he hops into his Land Rover to give me a tour. Traveling north, Small stops to greet some of his 80 employees: Samburu herdsmen leaning on ten-foot spears as they watch over small herds of cattle, part of the ranch's total of 2,500 head. The grazing is plentiful now. The end-of-the-year "short rains" have come early, and the landscape is green instead of its customary yellow-brown.

Beasts are not yet blasé about human intruders

On a plateau near the ranch's dusty landing strip, we come to a stop. Next to the road, a half-dozen giraffes stare at us curiously before loping off in graceful slow-motion gallops, their improbable necks pumping back and forth. Less skittish and far more dangerous, 60 or 70 Cape buffalo stare at us suspiciously. In contrast to the zoolike inhabitants of Africa's game parks, these beasts are not yet blasé about human intruders. Nearby grazes a small group of eland, the largest and reportedly the tastiest of Africa's antelopes, and beyond them a



An acacia tree is food for elephants, home for bee boxes. Pat Jacobberger Jellison and Andrew Johnston use spectrometer to "ground-truth" satellite images of the area. Bob Faden puts plant specimen in press.



herd of café-au-lait-colored Grant's gazelles. A kori bustard, one of the world's largest and most reluctant flying birds, picks its way on foot through a herd of Grevy's zebras. Farther off, a family of elephants browse contentedly, while in the distance a pair of yellow-billed storks come in for a landing, their enormous black-and-white wings flashing in the sunlight.

Small is as enraptured by the show as I am. "This is such a fantastic part of the world. I can't believe I can go climb a kopje and down below me are a hundred elephants! It's just unreal," he says almost to himself, shaking his head. "I guess they just feel safe here."

The elephants don't know it, but Mpala and the land around it, in Kenya's mile-high Laikipia Plateau, aren't officially protected. The plateau, however, is dominated by huge private ranches like this one, so the wildlife populations have stayed largely intact over the years. The elephant herd in Laikipia today is the second-largest in Kenya and the largest outside a park or reserve.

Wildlife, livestock and people live together

That Mpala is a working cattle ranch, not a wildlife sanctuary, is part of what makes it uniquely valuable for research. Most wildlife scientists in Africa do their fieldwork in officially protected national parks and reserves. Yet most of the wildlife lives outside the parks. Now, with human populations surging and animal habitats shrinking, Kenya and other countries urgently need to find ways for people, livestock and wildlife—large mammals in particular—to coexist on the same land without destroying it, or one another. Mpala can be a test case.

Officially, the Mpala Research Centre occupies only the southeast corner of Mpala Ranch, but visiting scientists are free to move around the 50,000 acres most of the time. The center itself is a small cluster of low buildings surrounded by thatch-roofed huts, called rondavels, tucked unobtrusively into the hillside scrub a few miles south of the ranch compound. A wide range of donors chipped in to make it materialize, among them British Airways, Citibank and the United Nations Environmental Programme. The British Army for years has used a corner of the ranch for bush training, and it returned the favor by putting in roads, pouring building foundations and installing a water system for the center. The result is rustic but comfortable. There are hot showers, laundry service, part-time electricity, jeeps for the borrowing and three hot meals a day (served in a dining hall paid for largely by the Smithsonian Women's Committee). Milk is brought in on camelback.

Pat Jacobberger Jellison appreciates every bit of it. The geologist works at the Center for Earth and Planetary Studies, a department of the Smithsonian's National Air and Space Museum. She's been doing fieldwork in Africa since the early 1980s. "In Botswana and Mali, I

was packing everything in by car, all the water and everything I'd need for up to eight weeks." At Mpala, less time spent doing camping, she says, means more time spent doing science.

In her case, doing science means studying desertification. "Mpala, for me, is a window that helps me visualize what the Sahara and the Kalahari were like thousands of years ago," she says. Kenya's savanna teems with cattle and wildlife today, but even small changes in climate and land use could alter that drastically. "Geologists like me are used to thinking in geological time, but desertification can happen pretty darn fast." By combining her work in deserts, the desert fringe and savannas, she hopes to tease apart the reasons—natural as well as man-made—that dry but productive land like this can so easily become wasteland. "The whole of East Africa and much of the developing world is concerned with this question," she says.

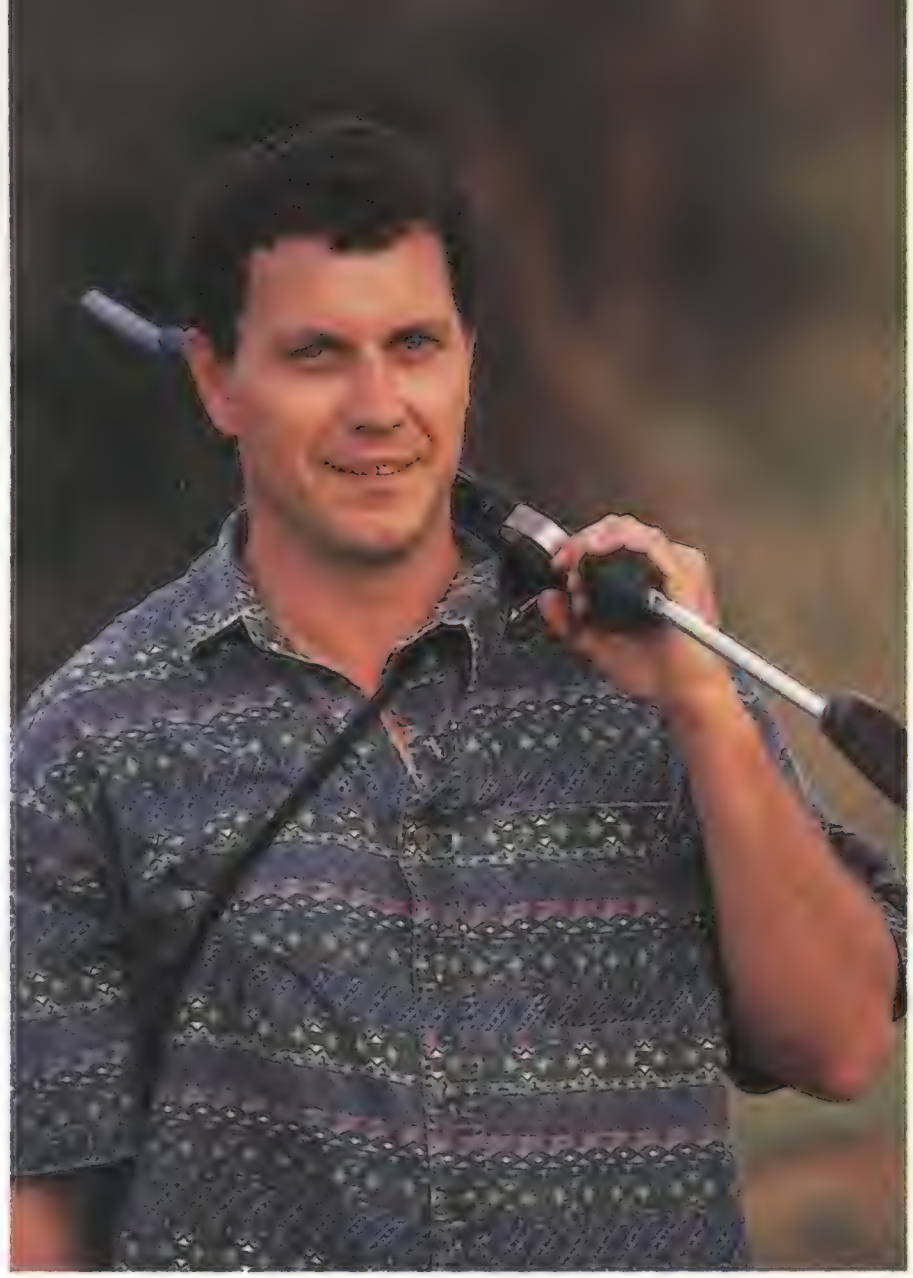
Jacobberger Jellison's specialty is remote sensing: detecting and tracking changes in Earth using satellite pictures. "Satellites tell you what color and where," she says as we bounce along a rutted dirt road early one morning on our way to the north edge of the ranch, 20 miles distant, "but to figure out what the color and brightness *mean*, you've got to go there." With us are Andrew Johnston, her assistant, and Bob Faden, a botanist from the Smithsonian's National Museum of Natural History, who's compiling an inventory of Mpala's plants.

We stop first at a picturesque spot at a bend in the Ewaso Narok, a fast-flowing stream punctuated with rapids that marks the ranch's northern border. This is riverine thicket, one of the half-dozen distinct habitats that make the ranch so biologically rich. The trees overhanging the mud-brown water are elegant, yellow-barked fever thorns (so named because people long associated them with malaria; rivers nourish both), while tangles of thorny shrubs crowd the banks. This part of the river is frequented by crocodiles, we're told, so I keep a nervous lookout as we hop from rock to rock in a pool along the main stream. Jacobberger Jellison happily chips rock samples for her collection, unconcerned about the crocs. "Come on, I've got a rock hammer," she laughs, when I bring up the subject.

Satellites like Landsat and SPOT, she explains, measure the brightness of the ground underneath in several different wavelengths—visible and infrared. By using a computer to mix the different readings in various ways, she and Johnston can try to divine things like foliage moisture, soil composition, even soil moisture.

"On a global scale, satellites are cheap and easy to use, compared to monitoring by plane or on foot," Jacobberger Jellison says. Still, this work, what remote-sensing people call ground-truthing, is needed to make sure that satellite models are reliable; can you tell a euphorbia forest from an acacia thicket, for example? "If all we wanted to understand was Mpala, we wouldn't need satellites," she explains. But she wants the lessons learned here to be useful around the world. So far, it's too early for answers, she says; arduous, muddy grunt work like this has to lay the groundwork.

Heading south, we stop on a high, grassy plateau to take spectrometer readings and soil samples. Next to us is a fenced-off area resembling an oversize tennis compound gone to seed. These are animal exclosures, and they're actually brand-new. Some of the exclosures are designed to keep out everything larger than a dik-dik; other plots have more-porous fencing intended to stop only "megaherbivores," elephants and giraffes. Cattle are periodically allowed in some of the plots and excluded from others. The idea, devised by Truman Young of the University of California at Davis, is to find out what happens to land and the savanna community when vegetation is munched on by different combinations of animals. Among the debates all these fences could help settle: Are elephants bad for cattle (they



Nick Georgiadis, director of Mpala Research Centre, uses his dart gun to "shoot" an elephant (opposite) in the leg to collect DNA for his gene-sequences study.

Douglas Stewart, now an experienced bush driver, is a regular contributor to SMITHSONIAN.

compete for the same grass) or good (they knock down trees, thus letting new grass grow)?

Nearby, Bob Faden wanders off distractedly, a pair of gardener's shears at the ready. Faden is an old Africa hand whose professorial demeanor is softened by a mild Bronx accent and an unexpected giggle. The dominant plants on this part of the ranch are low, gnarled-looking trees whose huge spiky thorns all but obscure their delicate foliage. These are whistling thorns, Faden says. The name comes from the sound they make when wind blows across the holes in the hollow, radish-size ant galls studding the trunks and branches. I tap a low branch, and instantly thousands of reddish-brown ants swarm out from their hiding places and scramble over one another maniacally until nearly half the little tree is a writhing, electric reddish-brown. "When a giraffe starts to browse," Faden explains, "the ants come out and sting it." The giraffe likes the foliage enough to take a few mouthfuls, but the ants dissuade it from overindulging. "The plant provides a home for the ants, and the ants provide protection for the plant."

A botanist to the core, Faden differs with Jacobberger Jellison's characterization of the whistling thorn as the "tree from hell." His view: "I much prefer whistling thorns to elephants. If I had my druthers, I would work in habitats that do not have large dangerous animals in them." Faden's perspective is colored by experience. I first caught sight of him here at Mpala as he dashed from behind a tree next to the dining hall having just bumped into an irritable—and enormous—bull elephant. It's not only that such encounters can be dangerous that worries Faden. "Elephants are a nuisance at best—they sometimes eat your study plants."

Nick Georgiadis is more accustomed to dodging elephants. The laid-back director is a British citizen born and raised in Kenya. He left Washington University in St. Louis, where he was a research associate, last year to get the Mpala center started. He has been studying elephant DNA, in pursuit of which he's stalked wild elephants (with a dart gun, not a rifle) throughout East and southern Africa.

As a population geneticist, Georgiadis understands the value of basic, academic-style research. Two examples are a pair of long-term animal behavior studies undertaken here, one of baboons by Philip Muruthi, a Kenyan doctoral student at Princeton, and one of mon-

Kenyan Philip Muruthi, a Princeton doctoral student, observes baboons for a long-term animal behavior study.

Baboon leader protects family and turf by displaying its well-known temper when humans come too near.

gooses by Steve Takata of the University of California at Berkeley. But as the director, Georgiadis, like George Small, makes clear that the projects he looks on most favorably are those conceived and carried out by Kenyans to deal with real-world problems.

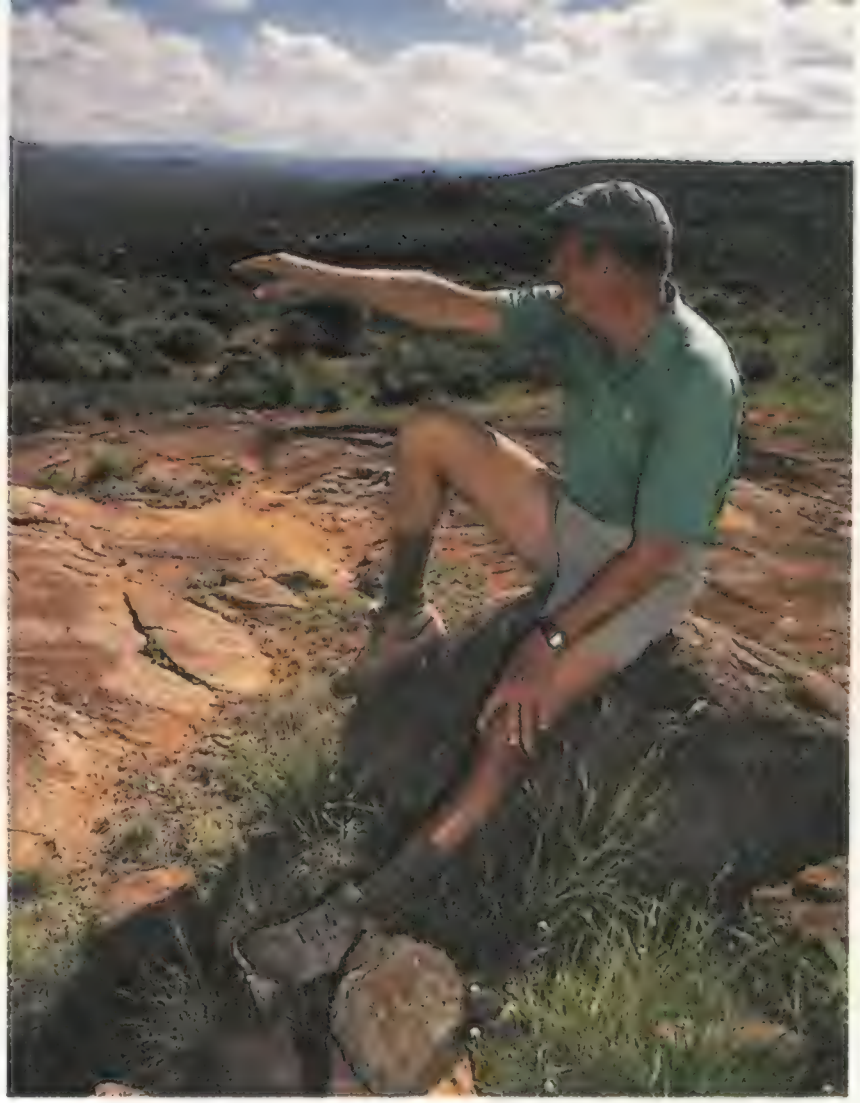
"We know so little about the environment that we can actively use to perpetuate natural processes, but these natural processes are now threatened by human activities," Georgiadis says. "At Mpala we intend to tackle these real-world problems using an academic approach; we will try to mesh the applied and the academic together to learn things about the environment that are not only new to science but also useful. Forget going to Mars, forget nuclear fusion—these are childish distractions compared to a far more complicated and challenging system: the global environment."

During my stay, I meet three Kenyan doctoral students at the center who are doing the kind of fieldwork here that Georgiadis encourages. All are supported by Citibank fellowships. Bell Okello, a member of the Luo tribe, has begun a study of the environmental impact of the common practice of cutting down whistling thorns to make charcoal. "Everybody uses charcoal here to heat water and to cook," he says, "but our sources of charcoal are declining." He cites a recent report predicting that after the year 2000, Africa may be threatened less by a lack of food than by a lack of energy to cook it. He wants to find out how much wood for charcoal a field of thorn trees can yield, year after year, without suffering.

His friend David Kinyua, an earnest, bespectacled Kikuyu, is comparing the effects of age-old African practices like bush-clearing and field-burning on the quality of the grasses that gazelles and zebras, as well as cattle, depend on. Oscar Wambuguh, meanwhile, a genial, outgoing student at the University of California at Berkeley, is studying property and crop damage by wildlife—a hot topic in Kenya, which has one of the fastest-growing human populations in the world. (The resulting spread of subsistence farming, according to David Western, chief of the Kenya Wildlife Service, poses a greater threat to wildlife than poachers do.)

The hunt for elephant DNA

Georgiadis' own research, though esoteric, has a clearly practical side. His DNA analyses strongly suggest that African elephants are not one species but two, forest and savanna, each with its own genetic history and adaptations. This means that trying to protect elephant populations by mixing mismatched herds is unlikely to work. (Wildlife authorities in Kenya recently set up a corridor to allow savanna elephants in arid, overcrowded Amboseli National Park to move to wetter, understocked forests on the northern slopes of Mount Kilimanjaro in Tanzania. The animals didn't cooperate.



George Small, rancher and conservationist, gave land for the center and chairs the Mpala Research Trust.

Georgiadis continues to pursue his own research, and he offers to take me along on an elephant hunt to snatch a tissue sample with a biopsy dart. With John Wreford-Smith, who manages the ranch, and Muchat Loipatare, a game scout, we set off.

Driving up the road along a ridge, we scatter a troop of baboons, which turn to look at us resentfully as they lope off on all fours. A chanting goshawk, startled by our approach, takes to the air with a snake dangling from its talons. An elephant lumbers across the road in front of us and crashes into the heavy bush.

At the top of the escarpment, we find ourselves in a grove of euphorbia trees. Hazy blue plains stretch out below us on three sides. Mount Kenya, an extinct volcano—at 17,000 feet, the second-tallest peak in Africa—rises into storm clouds to our south. Kopjes and larger rocky hills erupt from the plains, their general north-south alignment giving them the appearance of top-heavy warships moving in convoy. The vista is enhanced by the fact that nearly all the trees around us have been toppled. Barren, cactuslike stalks and detached branches lie everywhere, like the remains of a rowdy fraternity party. Elephants apparently like a view when they dine.

Continuing on under Loipatare's guidance, we pinpoint small herds of elephants here and there but never in a dartable position. Finally, near a hippo pool at a bend in the Ewaso Narok, with the wind right and the ground reasonably open, we stop. Georgiadis grabs his

dart gun, and we sneak quietly through the orchardlike acacia scrub toward the water.

At the river's edge, midway between rapids and a waterfall, an elephant with huge tusks chews on an overhanging tree while her three offspring drink from a pool. Georgiadis stands in a narrow alley between two trees and sights his gun, but the animal is too far away. He needs to be within 50 feet. Getting into position is a tricky business. These are not the placid creatures you feed peanuts to at the zoo, nor even the kind you shoot videos of in a game park. These animals are wild, suspicious and aggressive, and to Big Mama intruders like us are most definitely a threat.

The mother elephant suddenly turns and faces us head on. Her massive ears fan out threateningly, and with a snort she heads right for us. I look for an escape route—it's either jump in the river or flee blindly through the bush. But at the sharp *Crack!* of the dart gun the elephant turns away, spooked. The foursome clamber up the steep, muddy slope of the riverbank and rumble off through the acacias, bellowing as they go.

Georgiadis coolly retrieves his dart from the ground where it's fallen. "I've done this more than 500 times in nine countries, and you can see it never gets boring," he says. Filling the hollow tip of the dart is a plug of pink elephant hide. "As far as I'm concerned, there's an infinite amount of DNA in that." When he's collected several samples, he'll take them all to the National Museums lab in Nairobi and study the gene sequences.

When I ask if he was scared, he dismisses the elephant's maneuver as a mock charge: "She couldn't have run on the rough ground at the edge of the river." Georgiadis is an unflappable sort, with a James Bond accent to boot, yet his face is dripping with sweat, and the weather's not all that warm.

Back at his office, he fills me in on his vision for the Mpala center. His hope is for it to become the training ground of choice for young environmental managers and biologists in Kenya and elsewhere in East Africa. Conservation biologists at the National Zoo in Washington are already helping to devise field-training courses. Ultimately, Georgiadis wants Mpala to support the growth of a cadre of independent African scientists.

And not just biologists. For far too long, he says, the human element has been left out of the study of wildlife conservation and management. Indeed, a manager today could benefit from training not just in biology but in psychology, sociology, diplomacy, law, history, comparative religion and business administration. Wilbur Ottichilo, the Kenya Wildlife Service's deputy director for biodiversity, told me in Nairobi: "Mpala Research Centre can be used as a model to demonstrate how wildlife conservation can be achieved through direct participation and sharing of wildlife benefits, and the support and involvement of the landowners and local people. Without these things, wildlife survival on private land cannot be guaranteed." Georgiadis concurs: "The problems in Africa aren't so much biological as human." Africa's wildlife cannot be protected by electric fencing or government fiat alone, he and others agree. Conservation can only work if it brings people tangible benefits—

Samburu herdsmen, whose tribe lives on Mpala land, watch over the ranch's 2,500 head of cattle.

and distributes them fairly. That means local communities must see an economic return from wildlife if they are to actively participate in its conservation. Ecotourism is one option for some landowners.

At dawn on my last day at Mpala, I stand in front of my hut and watch an enormous waterbuck with majestically arched horns gallop wildly across the clearing in front of the dining hall and dive into the bush. As the chorus of birds around me grows in volume and variety, I can easily see why old-school conservationists viewed Africa as a paradise to be defended even from its inhabitants, as Jonathan Adams and Thomas McShane recount in *The Myth of Wild Africa.* To someone from the United States, the setting here does seem unearthly. But Africa is real, and so are the needs of Africans.

Ross Simons, a senior adviser at the National Museum of Natural History, predicts that within five years the center will be sheltering economists as well as ecologists. "There's a battle for the heart and soul of the conservation movement," he says. "There's much more experimentation now than there was in the 1960s. Mpala is the living laboratory of that experimentation."

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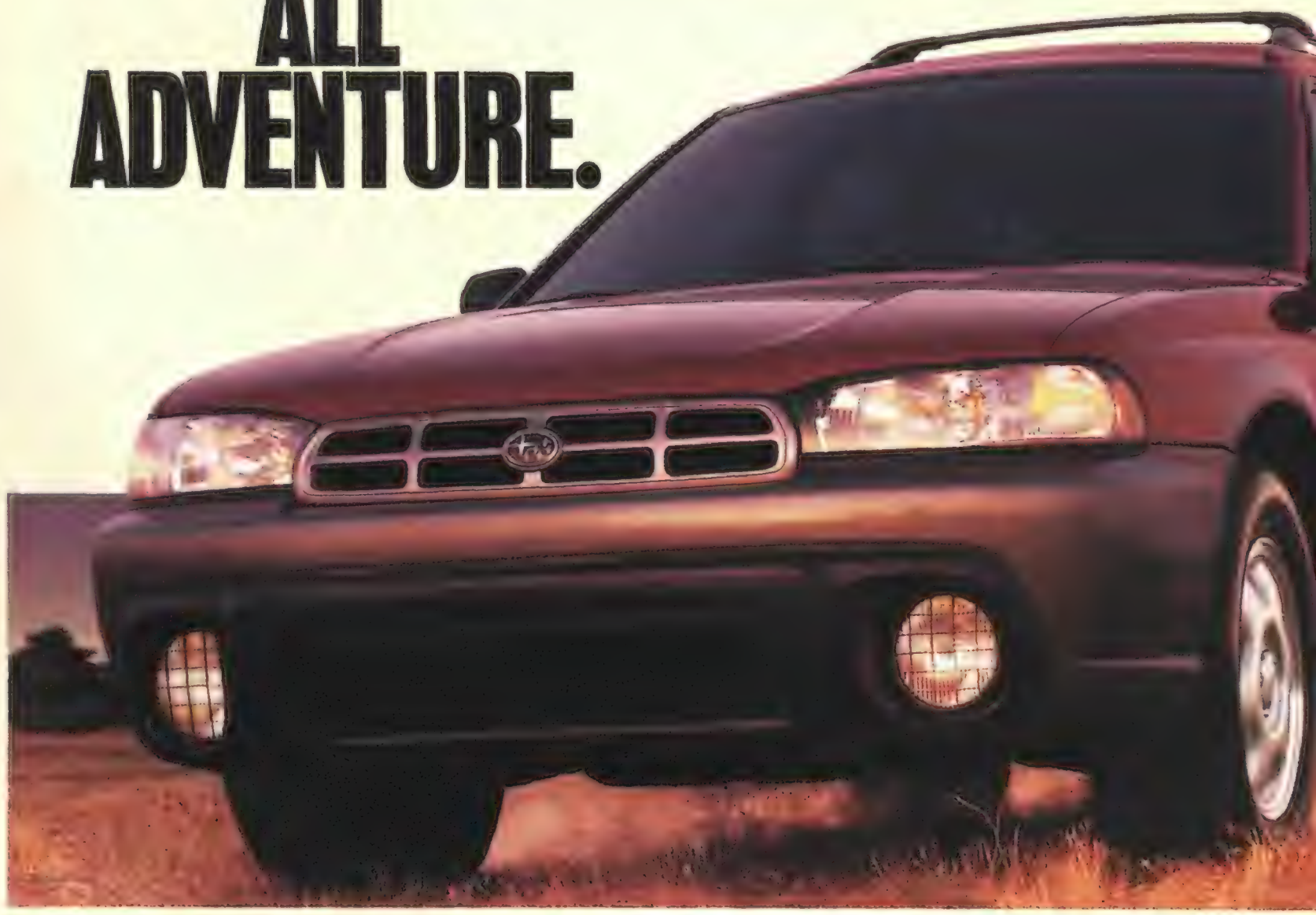

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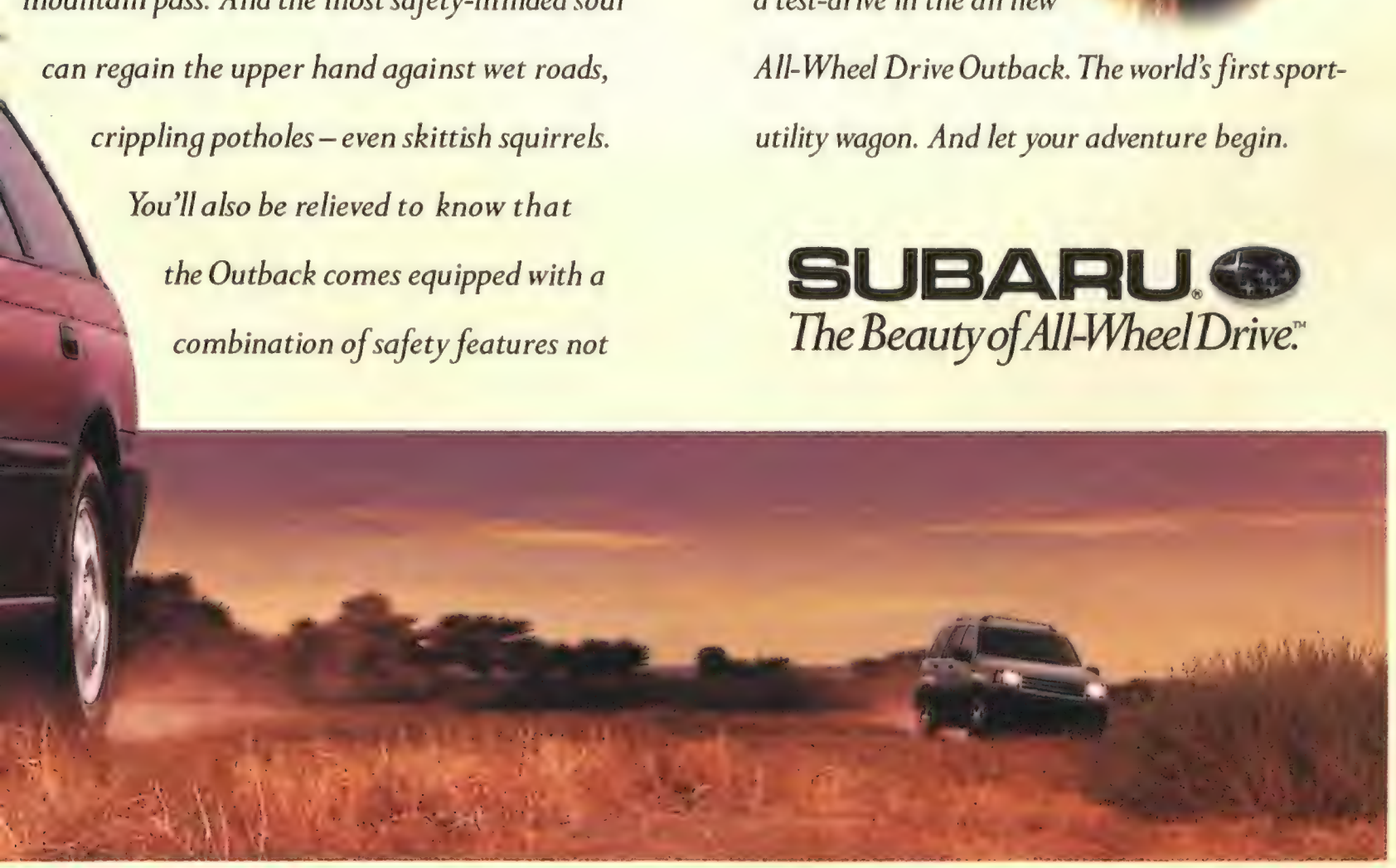

A curator hunts down the American photography collection of her dreams

In the Isaacs Collection: Clarence White's *The Rest Hour* from 1912 (opposite) and William Underwood's 1895 portrait of Joe Mell, his Passamaquoddy guide.

Merry Foresta is nothing if not persuasive, which helps if you're a museum curator with a very good eye and you know what you want. In this case, what she wanted for the Smithsonian's National Museum of American Art (NMAA) was a photography collection that she knew might not even exist. It had to be strong in 19th-century images that would not only stand up as works of art but also contribute to an understanding of the paintings, sculptures and other artworks at the NMAA.

And so it was that, a few years ago, Foresta visited Philadelphia collector and dealer Charles Isaacs. She was looking for American daguerreotypes to be included in a major show; Isaacs, she knew, specialized in daguerreotypes, as well as in European photography. By the way, she asked, did he know of a great collection of early American photography? One that included images of the Western landscape, everyday life, turn-of-the-century modernism, the Gilded Age. . . ?

"You mean, like this?" Isaacs said, opening a drawer and bringing out a gorgeous Eadweard Muybridge print. "Yes, like that!" Foresta exclaimed. "No, I don't

really know anybody who's put together a collection like that," Isaacs said with a smile as he shut the drawer.

"After several visits and several drawers opening," laughs Foresta today, "I said to him, 'Chuck, *you've* got the great American photography collection!' And he said, 'Yeah, I guess I do.'"

Not that Isaacs had actually set out to build this collection at all. He had intended to be a doctor but discovered in college that he loved taking pictures and hated the sight of blood. Ten years at the *Philadelphia Inquirer*, as a photographer and later as a picture editor, honed his eye. "Around 1985, I realized that the pictures I cared about the most were American," says Isaacs, "so it made sense to start concentrating on building the collection and filling in some areas."

Once Foresta and NMAA director Elizabeth Broun knew of Isaacs' secret collection, events took on an air of inevitability. "Merry was very persuasive, as was Bet-

Two different takes on the American West in the 19th century are (left) Timothy O'Sullivan's albumen print of Canyon de Chelly from 1873; and (above) a whimsical studio shot from San Francisco of a "forty-niner" walking street advertisement. In putting together the 303 images in the collection, says Charles Isaacs, one of his goals was "to place more classical pictures alongside pictures taken by ordinary photographers who weren't out there making 'art.'"

sy," says Isaacs; and when the deal was closed the Smithsonian had the seminal collection it had sought, most of it by purchase and some by gift. This November, 175 images from the Isaacs Collection will go on view at the NMAA. The exhibition and accompanying book will be the first occasion for the public to enjoy the benefits of a five-year partnership in American art recently established with the museum by the Consolidated Natural Gas Company Foundation and dedicated to preserving the American heritage through photography.

When the show opens, Isaacs will come by to tip his hat to his old friends. "It was unexpectedly difficult to part with them," he reflects; "and I'm used to parting with pictures on a regular basis. But I'm especially happy that they are at the National Museum of American Art. I was born in D.C., and I love the NMAA . . . It was always the friendly museum, the familiar one."
Constance Bond

The identities of the woman and the child in her care who sat for a daguerreotype (above) at the New York studio of George Gurney are not known. In the 1840s and '50s, people flocked to shops that sprang up around the country, eager to get their portraits taken. "Somehow, the daguerreotype communicates an intimacy, both between the viewer and the image, and among the subjects pictured," says Charles Isaacs. Civil War photographer George Barnard took this elegiac picture (right) at Bonaventure Plantation near Savannah after photographing General Sherman's progress from Tennessee to Atlanta in 1864.

Anne Brigman's 1906 platinum print *The Dying Cedar* (right) is typical of her poetic approach to the female figure and the landscape. Wife of a San Francisco sea captain, she was a member of Alfred Stieglitz's Photo-Secession group. Another who joined Stieglitz's circle was George Seeley, of Stockbridge, Massachusetts, whose *Still Life with Vase and Apples* from 1916 (below), a gum print, exemplifies the artistic "pictorial" ideals that Stieglitz championed. *Niagara in Summer, From Below*, 1888 (opposite), was taken by George Barker, who shipped photographs throughout the world from his shop at Niagara Falls. Europeans were enthusiastic customers; in fact, Isaacs found this image in Europe.

TECHNOLOGY UPDATE

Experience the benefits of technology... *at home!*

Where is the first place you'd expect to encounter technology? In the past, your answer would probably be "at work." Technological advances have long been simplifying our lives at work: computers, fax machines, E-mail...the list goes on.

But more and more people are discovering the benefits of technology in products for the home. Each of these products—from a solar lighting system that utilizes industrial technology to a computerized cat litter box—use technology to make our lives easier...at home.

With convenient wireless installation, two lighting systems offer the brightest solar light ever available!

Alpan's industrially-proven solar technology harvests the power of the sun to protect your home and family.

How many nights have you had to negotiate a walkway or fumble with your keys in the dark? Even if you leave the porch light on all day, you still have to find your way to the porch in the dark! Now there's a better way: Alpan, in collaboration with Siemens, recently developed two amazing lighting systems—the **Solar Pagoda** and **Solar Sensor Lights.**

Exclusive features

1. Circuitry sealed in weather-protected casing
2. Silicone-encapsulated solar cell
3. High-capacity batteries provide up to five hours of illumination
4. Energy-efficient fluorescent bulb burns eight times brighter than incandescent bulbs
5. Height-adjustable mounting stakes fasten together with no hardware to rust

Fluorescent advantage. Using a four-watt fluorescent bulb, the new Solar Pagoda Light provides the maximum amount of illumination while operating on a minimum amount of energy.

In fact, the fluorescent tube found in the Solar Pagoda Light is eight times brighter than normal incandescent lights.

State-of-the-art. Alpan lights use a *single crystal cell,* the same cell found in industrial power modules. Energy collected from the sun by the cell during the day charges the power source. A built-in photo sensor detects darkness, automatically turning the light on to provide up to five hours of illumination.

No bills, no wires. You can install the Solar Pagoda Light in minutes. Snap the mounting poles together—you can choose the height of the poles, from eight, 13 or 21 inches. Then just snap the light onto the pole and insert it into the ground. All of the connections are internal, so the lights are totally wireless. And because they store and use energy from the sun, you'll never pay for outdoor lighting.

Solar Sensor. The Solar Sensor Light uses the same technology to provide extra protection for your home. This powerful floodlight illuminates your yard with a quartz-halogen bulb. Its built-in motion and heat sensor turns the light on and keeps it on for 30 or 60 seconds after motion is detected.

Effective *and quiet* air purification system finally available to the public!

New air purification system uses negative ions to actively remove contaminants better than any other filter and operate in total silence.

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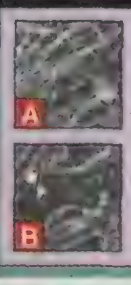
Proven technology. Clearveil is a fanless electronic air purifier that uses patented microprocessor-controlled ionization and collection technology for contaminant removal.

The best method. In the past, the HEPA filter was considered to be the most effective air purification method. But Clearveil's technology is significantly more advanced. Studies have shown Clearveil to be more effective in capturing a higher percentage of even the smallest contaminants.

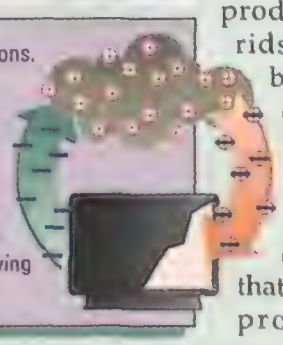
HEPA filters have a certain level of permeability because they must allow air to pass through them. This means that small dust particles including bacteria, viruses, smog and tobacco smoke are also free to pass. But Clearveil's non-permeable sheet doesn't allow those particles to escape. This makes a big difference to anyone concerned with pure, pollutant-free air.

CLEARVEIL ADVANTAGES



After 168 hours of use, the Clearveil filter (B) has collected much more dust than the HEPA filter (A).

1. Clearveil releases negative ions.
2. Negative ions combine with positively-charged dust to form a negatively-charged unit.
3. Then a collection plate with a positive charge attracts those negatively-charged units, removing them from your air and home.



Without any wiring, the Sensor Light installs easily. Mount the solar panel on your roof, mount the light anywhere and connect them with the 14-foot cord. It's that easy!

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Risk-free. Both systems come with our risk-free home trial and a one-year manufacturer's warranty. Try them, and if you're not satisfied, return them within 90 days for a "No Questions Asked" refund. ■

Clearveil is so compact you can put it just about anywhere!

Energy efficient. Clearveil only uses about four watts of electricity—you can run it 24 hours a day for about $4 a year! One Clearveil unit will purify a 250-square-foot area.

Feel healthier. Negative ions do more than just remove the harmful contaminants from the air that you breathe. They can actually improve your environment, making it healthier and more invigorating.

Guaranteed performance. For a limited time you can purchase Clearveil for just $199. We guarantee you'll notice a difference in the air you breathe and that Clearveil will operate in total silence. If you don't agree, return it for a "No Questions Asked" refund. It is backed by our 90-day risk-free trial and a one-year manufacturer's warranty. ■

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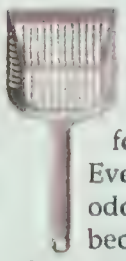
You and your cat will love the way LitterMaid eliminates the hassle, mess and odor of the ordinary litter box.



House cats. They all pose the same problem for their owners—the litter box. Few things I can think of are as foul as cleaning the litter box at my house. Even with daily cleaning, it's difficult to keep odor away. And this problem is multiplied because I have two cats! But because I love them, and that's virtually all the maintenance they require, I do it...there's just no other option.

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What do I have to do? LitterMaid is fully automatic. Just fill the pan with *clumping* cat litter (a premium brand will give the best results). LitterMaid does the rest! When the waste container is full, just throw it away and put a new one in its place!

Good for your cat. Most cats dislike using litter boxes that are dirty, and that can lead to them not going to the bathroom. Or worse, they may choose to use the bathroom around the house! LitterMaid keeps the litter box a clean, healthy place for your cat.

Try it risk-free. LitterMaid is backed by our exclusive risk-free home trial. Try it, and if you're not completely satisfied, return it within 90 days for a full refund, "No Questions Asked." It's also backed by a one-year manufacturer's limited warranty. ■

Computer technology revolutionizes the litter box...

LitterMaid, a patented product from Waters Research Company, is a completely self-cleaning litter box operated by a microprocessor, but your cat uses it just like a normal litter box. Approximately 10 minutes after LitterMaid's "electric eye" senses that your cat has left the litter box, it signals the start-up of the automatic sifting comb. ★The comb sifts through the litter, scooping up any waste. ★★The waste is deposited into a sealed, air-tight waste container and the comb returns to its original position, smoothing the litter. The system resets, ready to repeat its cycle the next time your cat uses the litter box. ★★★When the waste container is full, either throw it away and put a new one in its place or empty it and reuse it for up to one year!

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By Richard Conniff

Clyde Roper can't wait to be attacked by the giant squid

After studying (and eating) smaller squid for years, the Smithsonian's cephalopod man is now ready to face the biggest calamari of all

Depicted as a cross between an octopus and a squid, the monster in a 19th-century engraving mauls a ship.

Roaring seaward off the coast of Florida, the boat, a rehabilitated drug runner, sluices up veils of spume. Rainbows flash and atomize at the rails. On a captain's chair amidships, Clyde Roper sits, contented, earplugs in, bracing himself with feet set wide. He is an unusual character, especially considering the strange quest he has undertaken. It's as if somebody crossed Ahab with everybody's favorite high school science teacher. He is 58 years old, with a gray jawline beard and a New England lobsterman's accent he earned as a teenager working his own boat in New Hampshire. He once arrived at a lecture bearing a four-foot-long squid on a stretcher and, taking the podium, inquired, "OK, who ordered the calamari?"

Today he will be collecting specimens on the edge of the Gulf Stream. The boat, operated by the Smithsonian Marine Station near Fort Pierce, stops 17 miles out, in 750 feet of water. Roper bolts a yellow sledge to the trawl cable and sends it over the side, followed by the plankton net, a ten-foot-long cone of fine mesh tapering down to what looks like a mayonnaise jar. The catch will consist of larval squid and other planktonic life-forms.

Roper, a zoologist at the National Museum of Natural History, has sailed over every ocean on Earth, and dived beneath many of them, studying squid, octopuses and cuttlefish, together known as cephalopods. He has observed how some of these creatures use light to communicate in the rich language of bioluminescence. He has described minute structures, like goosebumps, in cephalopod skin and theorized about what role they may play in hydrodynamic streamlining. He has also identified one new family, two genera and about 20 species. Beginning this November, as the culmination of his life's work, Roper will lead an expedition in search of one of the last great monsters of the sea, the giant squid, described by Herman Melville himself as the "white ghost. . . . which . . . few whale-ships ever beheld, and returned to their ports to tell of it."

Tales of many-armed sea giants haunt the literature of maritime nations going all the way back to Homer's *Odyssey*. By the late 1800s, enough physical evidence had turned up to prove that huge cephalopods do exist.

We tend to think of invertebrates as puny, mindless things like midges and slugs, but the giant squid, genus *Architeuthis*, can grow to a length of 60 feet, almost twice as long as a schoolbus. It has eyes the size of hubcaps. In addition to its eight arms, it has two lengthy tentacles ending in sucker-lined clubs, which it can lash out to seize its prey. Despite its size, no one has ever seen the giant squid in its natural setting, 500 fathoms down. That is what Roper aims to do.

Monstrous cephalopods—beasts like the many-armed Scylla in Homer's *Odyssey*, and the many-headed Hydra of Herculean lore—abound in mythology. In *Twenty Thousand Leagues Under the Sea*, a giant squid grappled ferociously with the submarine *Nautilus*. Jules Verne is said to have based this epic battle on an actual encounter between a French warship and a "colossal and slimy embryo" that could open its parrot-beak mouth about one and a half feet. Not to be outdone, Peter

Chopsticks at the ready, zoologist Roper enjoys a light moment with specimens in his office at the National Museum of Natural History. He savors squid whether fried, pickled in jars or spoofed in cartoons on the wall.

Benchley depicted the giant squid in his 1991 novel *Beast* as a man-eater driven to "instantaneous explosive spasms of destruction." Benchley's squid was also prone to clambering up over the transoms of large fishing boats (about the size, say, of the one in which Roper is now traveling), snaking its horrible tentacles across the decks and dragging crew members to their deaths.

By Roper's calculations, giant squid ought to be commonplace. They appear to inhabit almost every ocean, and roughly 200 of them have turned up over the past century stranded on beaches. Roper himself collected the battered carcass of one that washed ashore in Massachusetts in 1980; it's now on display at the museum, preserved in a clear acrylic coffin full of isopropyl alcohol, which Roper calls "the largest martini in Washington, D.C." Giant squid are also common enough that, in 30 separate incidents over the past ten years, they have come to the surface tangled in deepwater fishing nets. Earlier this year, biologists hauled in three dead ones off the coast of New Zealand. Still, no one knows how they live in the absolute darkness of their own world.

After 15 minutes, the man at the sledge winch yells "Surface!" and the first tow comes in. The net is flocked with pink crud, and the "mayonnaise jar" overflows with goo. Roper summons up his reservoirs of scholarly knowledge and concludes, "That's what goes under the category of snot," spilling out the sorry remains of a jellyfish. He hauls the net up on a davit, hoses it clean and sets it out again.

In between tows, he talks about the battle plan for his forthcoming expedition. It appears to hinge on finding a "friendly sperm whale" and letting it lead Roper to the squid. Sperm whales, he explains, routinely prey on *Architeuthis*. Ambergris, the precious waxy substance used in perfumes, actually is produced by the whale's intestines to ease the passage of indigestible squid beaks. Roper estimates that a 50-ton whale may eat three or four giant squid, each weighing up to a half-ton, every day. It catches the squid in its mouth and will occasionally wrestle it, still struggling, to the surface. The whales almost always bear scars of the squid's sharp-toothed suckers around their mouths.

The notion of a friendly sperm whale might give a prudent man pause, but Roper is patient and methodical. "I've been thinking about this giant-squid business for a long time," he says; in fact, it has been 35 years. When Roper was a graduate student at the University of Miami, a sperm whale stranded on a nearby beach. "We went for our dissecting kits, which consisted of double-bitted axes and a couple of hunting knives. As we left

Richard Conniff shares Clyde Roper's enthusiasm for calamari, but he likes his squid well fried. He wrote about moths in the February 1996 issue.

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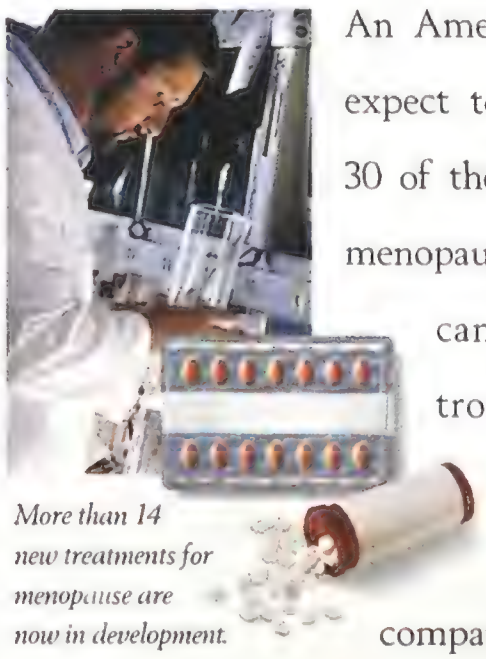

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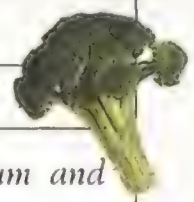
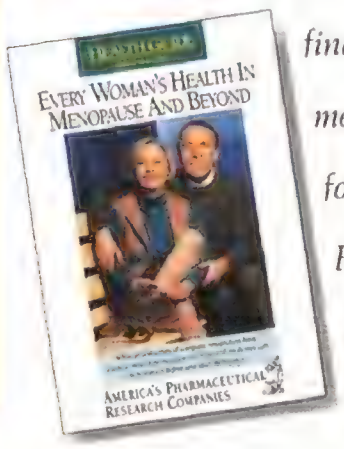
staying healthy



Make sure you get adequate amounts of calcium and vitamin D in your diet. Exercise regularly to promote bone health and overall fitness. And if you smoke, quit. To find out more about treatments for menopause, call (800) 862-5110 today for our free booklet, "Every Woman's Health In Menopause And Beyond," or you can visit us on the Internet: http://www.phrma.org



America's Pharmaceutical Research Companies

DISCOVERING 90% OF ALL NEW MEDICINES

Roper's colleague, New Zealand biologist Steve O'Shea, examines 26-foot-long squid netted earlier this year.

the lab, we grabbed a book off the shelf because, as invertebrate zoologists, we didn't know Shinola from beans about whales." Roper ended up deep inside the whale. "I got back to the third stomach, and sure enough, I could reach way down and bring out handfuls of squid beaks."

Roper emerged saturated in the whale's black blood. He went to rinse off in the surf, but a shark had picked up the whale's scent. So he and his gore-smeared colleagues hopped back in their Rambler station wagon, with the whale's jaw strapped on top, and headed home, inflicting olfactory trauma at every tollbooth on the Florida Turnpike.

"I've looked at the biology of the giant squid," Roper continues, "and also of the sperm whale, the records of where strandings occur and the best concentrations of squid in stomach contents of sperm whales." Gradually he has narrowed the search down to an area off the coast of New Zealand. Last year he made scouting trips there and to the Azores, another hot spot for both sperm whales and giant squid. In the Azores he interviewed whalers who used to harpoon sperm whales by hand from small boats. (The killing of sperm whales was outlawed by the International Whaling Commission in 1981 to aid in the recovery of the species.) "It turns out that when a harpooned sperm whale comes to the surface, just before it dies, it vomits. So I said, 'That's great, what's in the vomit?' and they looked at me like, 'Man, is this guy weird,' and then they said, '*lula,*' which means 'squid.' 'What kind?' They said '*lula grande.*' 'How *grande*?' And every one of them would take both hands and grab their thighs, meaning the arms and tentacles were that big, and these guys were not wimps. I asked how often they ran into this, and they said that virtually every whale would have a giant squid in it. You do a little arithmetic—there are perhaps a million sperm whales in the world—and it follows that there have to be a lot of giant squid around."

The second tow comes in, and Roper digs into it with relish. A couple of assistants help him wash down the contents of the plankton net. Then all of them hunch over the tray into which they have transferred the concentrated catch. "Ooh, what a lovely soup!" Roper exults, pointing to a little squiggle. "That's a squid right there. Fantastic! Outstanding!"

It is a soup within a soup. Beneath the boat, the Gulf Stream churns steadily to the north, bearing a rich stew of larval squid and other life-forms that supply fisheries from the Middle Atlantic States to the Maritime Provinces. There may be giant squid of almost any size out here, under the keel, even now.

As the boat turns back for port, Roper sits down, with the day's entire catch preserved in a few small vials in his shirt pocket, and attempts to explain his cephalopod obsession. The biological class known as Cephalo-

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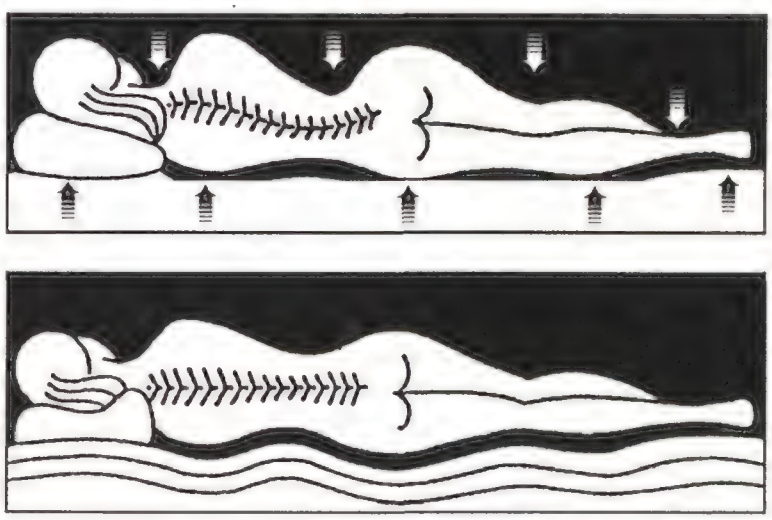

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poda, meaning "head-footed" animals, consists of two subclasses. On the one hand, there are the chambered nautiluses, a group with an external shell, which have remained largely unchanged for 450 million years. The second subclass, Coleoidea, consists of squid, cuttlefish and octopuses. Natural selection turned these cephalopods inside out: the flesh gradually engulfed the shell and reshaped it into an internal stiffening structure. In squid, this structure is a long, flexible rod called the "gladius," a word Roper explains with a sword-fighting flick of the wrist. In cuttlefish, it's a flat, oblong calcareous disk, which has become a familiar fixture in bird cages.

By internalizing their shells, these cephalopods accomplished an extraordinary evolutionary makeover. Once dull as clams, they became svelte and slinky free-swimmers. They also evolved a highly complex way of life, characterized by speed, stealth and intelligence.

Learning about squid in a school

"You've heard the phrase 'the observed observer?'" Roper asks, recalling what it's like to swim in small schools of foot-long Caribbean reef squid. "You know they know you're there. They will always, no matter how careful you are, maintain what is for them a critical distance. They won't be bothered by you, but if you swim forward into the critical space, the squid will move away. If you stop, they'll stop. If you back up, they'll move toward you. They have these great big shiny eyes, just gorgeous. They're really tuned in to what's going on around them."

Squid, octopuses and cuttlefish have evolved the largest nervous systems and brains of any invertebrate, which might sound at first like damning with faint praise. But their brains are generally bigger, in proportion to their body size, than those of their vertebrate competitors, the fish. What they do with them remains largely a mystery, but cephalopods lead far more sophisticated lives than we might suppose. Octopuses survive well in captivity and perform impressively on cognitive tests, learning and remembering simple tasks, like how to negotiate a maze; one octopus may actually teach another. Cuttlefish seem to recognize their individual caretakers. But most squid, built for open water, are too delicate to survive in captivity. We know more about how they behave on the dinner plate, *fra diavolo*, than in their own world.

Even the basic anatomy of these cephalopods—simple stuff like telling head from tail—can seem bewildering. The usual arrangement is to have the parrot-beak mouth in the middle, with the appendages arrayed around it like petals on a flower. The arms pass food into the mouth, where a tongue lined with raked-back teeth rams it down the gullet. Just behind the mouth, the esophagus passes through the middle of the brain.

Fins look like ears (top) on the "vampire squid from hell." For defense, jagged arms fold back like a skirt.

So if a squid takes too big a bite, Roper notes, "it'll ream its own brain out." (Mariners should not take comfort from this. While a giant squid is unlikely to swallow a person whole, it is quite capable of chunking you up into manageable bits.) The outsize eyes are just behind the mouth. Then comes the cigar-shaped mantle, which often ends in broad stabilizing fins at the tail.

Within this basic design, the cephalopods are amazingly diverse. Some press their arms together and shoot tailfirst through the water, sleek as torpedoes. Others, like one of the deep-sea squid, drift head-down along the bottom, with their two feeding tentacles sprawled out, trolling sticky suckers through the planktonic soup. When threatened, many deep-sea squid wrap their arms back over the head like a skirt, exposing rows of suckers armed with sharp teeth. One colorful squid (above) "guards" its squared-off tail with what looks like a diabolical imitation of a face. Scientists have named it *Vampyroteuthis infernalis*, the "vampire squid from hell."

The fanciful appearance of the cephalopods is nothing compared with their behavior. Intelligence in this world may have less to do with mazes than with the sub-

So-called giant cuttlefish, one and a half feet long, cruises a reef off Australia, on the lookout for a meal.

Cuttlefish can move rapidly and see well. Like squid, they swim with arms extended when they are hunting.

tle language of light and color. "In the skin are gezillions of chromatophores, little sacs of pigment," Roper says, "each of which is individually controlled by nerves that come from the brain. Cephalopods can mix and match colors for a number of functions." They can change their color, shape and position in the water to blend in with a spiky bed of coral. When swimming in the deep sea, squid may hide themselves with complex displays of light on their undersides, a phenomenon Roper and a colleague discovered in the 1970s. They recorded one squid as it varied the intensity of its bioluminescence 16,000-fold, in perfect synchrony with the shifting patterns of downwelling sunlight.

Cephalopods are famous for escaping behind a cloud of ink. The cloud is actually a mix of ink and mucus, which does not conceal but serves as a decoy to distract predators while the cephalopod gets away.

Shallow-water cephalopods may also put on a show of color to mimic some poisonous or predatory fish, or as a warning during courtship. "Sometimes a male will lie side by side with the female," says Roper, "and the side that's away from the female will be lit up with this incredible flame-stripe pattern: *Flash, flash, flash!* 'Stay away from her! She's mine!'"

In courtship, male and female may swim side by side for hours, shifting direction together as smoothly as Fred Astaire and Ginger Rogers. The key to their success is jet propulsion. The cephalopod mantle draws water in through openings behind the eyes and shoots it out again through a funnel located just under the head. The squid can swing this funnel around like a firehose to point in any direction.

To master jet propulsion, squid have evolved the largest single nerve fiber in the animal kingdom, 100 times thicker than a typical human nerve fiber. Neurobiologists have been studying this so-called giant axon for more than 50 years, and much of what we know about how nerve cells generate and conduct electrical messages comes from squid. But Roper would rather talk about what the giant axon does for the squid itself as it jets tailfirst through the sea: "The squid sucks water into its mantle. Then it locks the mantle orifice with two little lock-and-key mechanisms. So the signal comes from the brain to all those rings of muscle in the mantle

and says 'Contract.'" If the signal caused the rings nearest the head end to contract first, the water would be squeezed back away from the funnel and into the tail. "The squid would essentially blow its rear end off."

The giant axon prevents this catastrophe, because of one of the most basic rules of neurobiology: the speed of a nerve signal is directly proportional to the diameter of the nerve fiber. So the signal flashes instantly down the giant axon superhighway to the tail, then out the branching nerve fibers. All of this is engineered so that the signal reaches the hindmost ring of muscles first. Then the next-closest ring of muscles contracts, and so on sequentially to the head end, so the water is squeezed toward the funnel. Instead of exploding squid parts, the result is jet propulsion.

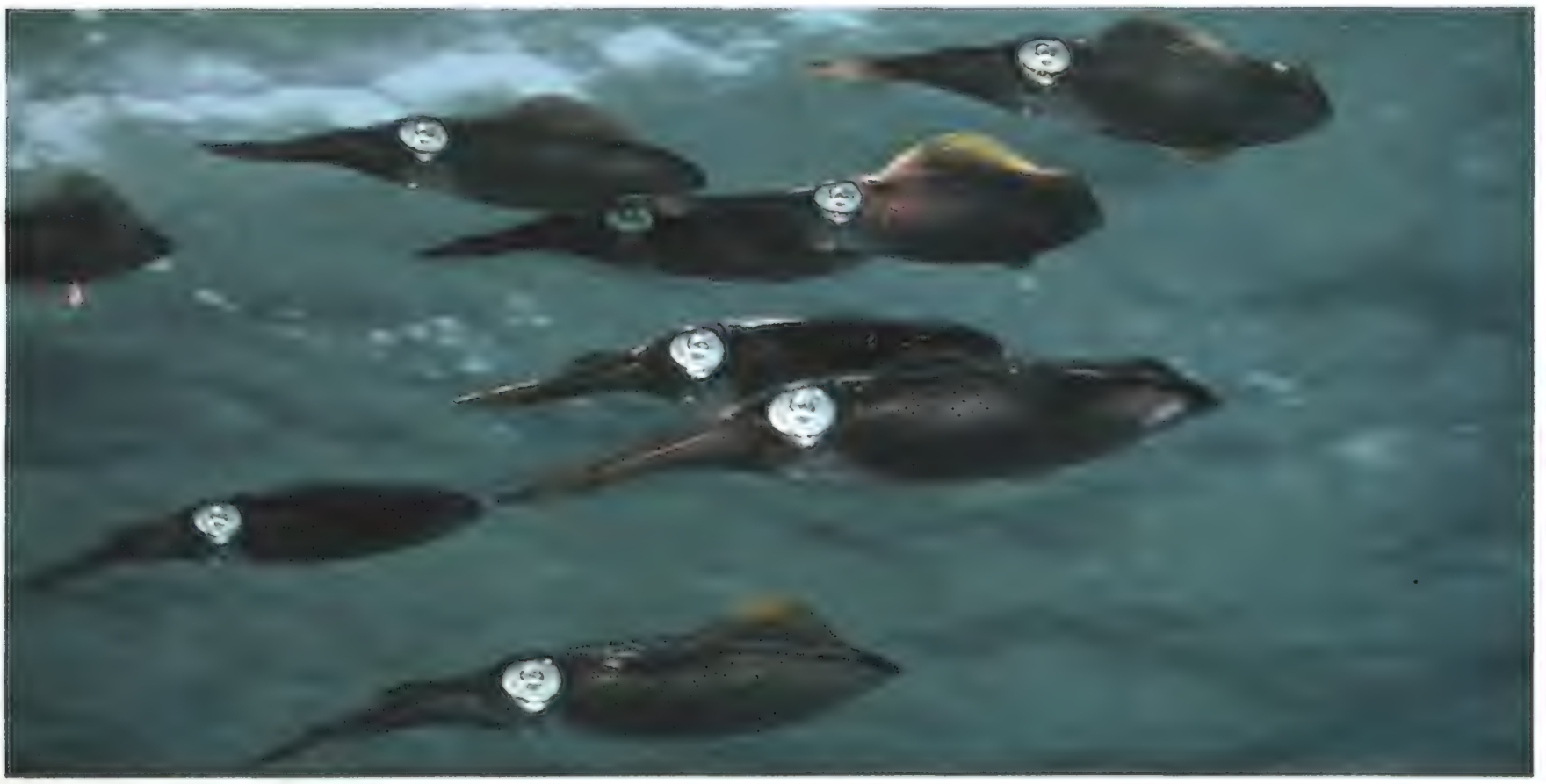
Roper is passionate not just about cephalopods but also about growing Thai hot peppers, jalapeños and habañeros, and the two passions often come together in a frying pan. In the cephalopod room at the museum, he keeps thousands of specimens in jars of preservative—and also an aromatic string of dried octopus and cuttlefish from the Hong Kong market, which he sometimes sniffs with great gusto.

"Cephalopods are about the perfect food," he says. "If you eat the mantle, there is virtually zero fat. The only way to get fat is to eat the liver, which they do in Japan. I must say, it's an acquired taste, and the speed of acquisition is directly proportional to the amount of sake you wash it down with."

Cephalopods are short-lived, fast-growing, prolific animals, all the things a robust fishery requires. Driftnet fishing for squid was recently banned, not because the squid populations were threatened, but because squid fishing often served as a cover for illegally catching more-valuable fish, like salmon, and because the nets incidentally killed thousands of sharks, dolphins and other species. But the worldwide catch is still more than two million metric tons a year, and cephalopods are increasingly common even in the notoriously squeamish American market.

Roper, who sometimes teaches classes in cephalopod cookery, recommends this squid recipe for diners seeking enlightenment: clean out the mantles, and stuff them with a mixture of the chopped arms and tentacles, rice, garlic, raisins and pignoli; pour in red wine, and then bake at 350 degrees for 40 minutes or so, depending on size. Baste with red wine as needed.

There is a venerable history of cephalopod scientists eating their research material. Over fried calamari one night, Roper recalls the eccentric 19th-century naturalist Constantine Rafinesque, who taught at Transylvania University in Kentucky, where Roper himself was later an undergraduate. Rafinesque once reported a new species of octopus and wrote, "I did eat this *Ocythoe* which afforded a meal for many, and it was as good as usual with the Octopus." Unfortunately, what he had eaten was the only known specimen, and *Ocythoe tuberculata* was not found again for another 82 years.



Bearing eerie resemblance to a squadron of ETVs, a school of Caribbean reef squid jets through turquoise waters. Sunlight reflecting on the creatures, each less than two feet long, causes their eyes to iridesce.

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Fisherman holds an eye of a Humboldt squid, a species that grows 12 feet long and is known to be aggressive.

Roper's culinary adventures have occasionally yielded scientific results. Some years ago he was serving as an examiner for a doctoral candidate in Newfoundland. Afterward the new PhD and his wife invited everyone home for dinner, which consisted of cephalopods in 12 different dishes, plus an ample supply of beer and a local rum called Screech.

"So we got to talking about giant squid," Roper says. "I wondered if giant squid would be any good to eat, and the new PhD said, 'Well, I have a piece in my freezer.' He was a cephalopod man, and a lot of giant squid strand in Newfoundland. So we thawed it out and prepared it, and it was absolutely awful, very bitter. One of the other examiners and I looked at each other and at the same time we said 'Ammoniacal!'"

This was literally food for thought. One of the questions about the giant squid is whether it is a fast, powerful swimmer, as the monster hypothesis implies. The ammonia taste in its muscles that night suggested otherwise. Ammonium ions are lighter than water. They should enable the giant squid to maintain its buoyancy without spending a lot of energy swimming. Following that dinner, Roper and his colleagues determined that *Architeuthis'* muscles are soft and spongy, and that their jet-propulsion equipment is less powerful than that of smaller squid that are known as strong swimmers. Hence the sluggard hypothesis: giant squid are basically big, lazy cruisers. They can get enough to eat by simply hanging around and, every now and then, shooting out their tentacles like a frog's tongue to snag some passing fish or squid. No speed known to squid, Roper believes, would save them from their one predator, the sperm whale.

Roper's plan is to stay close to sperm whales during his four-month expedition. That way, he believes, he will find their richest hunting ground for giant squid—probably somewhere off the coast of New Zealand. One of the things he hopes to accomplish is to track the whales acoustically. "Some people think that they hunt by sonar. The pattern of the sonar signal starts with a slow clicking, and then it becomes increasingly rapid, until it's almost a buzz: *Click . . . click . . . clickclickclick . . . zzzhh . . .* and then it stops. *Boom!*" He slams his hand down on the table. "And that's when the squid is eaten." It may turn out, however, that sperm whales don't hunt by sonar at all, but by vision.

From the mother ship, Roper will be able to send down unmanned submersibles equipped with powerful lights and cameras. He will also descend, himself, in the bubble-fronted *Johnson-Sea-Link* submersible (SMITHSONIAN, January 1996). "I imagine us moving along very slowly and as quietly as we can in the sub," Roper says, "and seeing first in the distance, as far as our lights can go, a hazy form, and suddenly realizing that it's an *Architeuthis* out there. I'm hoping that it will not be frightened, so we can get close enough to see the whole animal. We'll be able to learn more about it in a few seconds than we've ever known before.

"We'll see how it orients itself in the deep sea, horizontal or vertical, head up or head down. We'll be able to tell if it uses its fins for swimming. Does it hover in mid-water? Does it sit on the bottom? We may be able to determine how it holds its tentacles. If we are lucky, we might be able to see it capture prey."

The conversation wanders to the question of whether the giant squid might produce an ink cloud, and whether that cloud would be bioluminescent or stretch out as long as the animal itself. Roper says, "It would be wonderful to get the giant squid to think that we're a predator, and exhibit the full range of defensive behaviors . . ." He hesitates a moment.

"The other thing that would be wonderful . . ." Roper's eyes light up behind his bifocals and he cackles with anticipatory glee, "would be to have the giant squid attack us. Can you picture us being in this big fishbowl, five or six feet in diameter, and having this giant squid completely envelop it, with the suckers all around? And seeing the beak just this far away, scraping against the acrylic? Wouldn't it be great to see?"

His dinner companion nods, a little dumbfounded. Their bowls of calamari are empty now. "It would be time to surface at that point," Roper concludes. "Blow all the ballast, but keep the camera running, and radio up to say, 'Hey, we have a friend on board.'"

Reflective cells on a bigfin reef squid give it a ghostly aspect. The species is found in Indo-Pacific waters.

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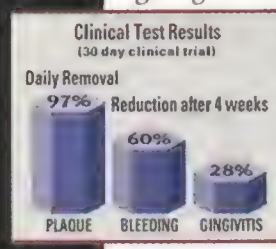

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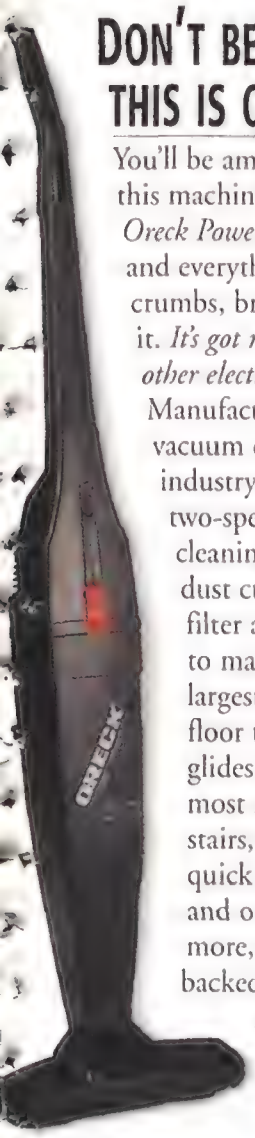

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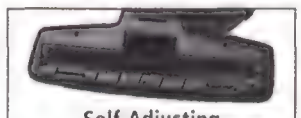

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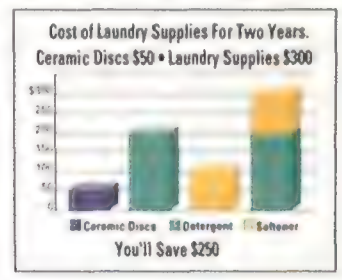

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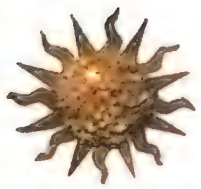
By Sue Hubbell

How taxonomy helps us make sense out of the natural world

We all have a need to classify plants and animals, which is what the National Museum of Natural History does on a grand scale



In the past months I've come to know, tolerably well, a big, beautiful spider. She is blotchily orange and tan with darkly banded legs. Each day she spins a fine new round web somewhere in the garage. Her eyesight is none too good and she usually sits off the web, hidden against a protecting beam, but when moths and flies blunder into her trap, she can feel the vibration on one of the web's guying threads and she rushes out. She eats the first and wraps the others in silken winding sheets to keep for later. I try to avoid tearing her web and save her repair work, but I know she is a quick and efficient spinner. Jonathan Coddington, the chairman of the entomology department and curator of spiders at the Smithsonian's National Museum of Natural History, tells me she eats each day's web and reprocesses the protein. Within 20 minutes of munching it down, she can spin recycled silk.

Her common name is barn spider. Her scientific one is *Araneus cavaticus*. Her genus, indicated by the first word in her scientific name, includes a greater number of species—more than 1,500—than any other spider genus. The genus name and that of her order, Araneae (the spiders), as well as that of her class, Arachnida (spiders plus a lot of kinfolk: ticks, daddy longlegs, scorpions and suchlike), echo the name Arachne, borne by a Lydian princess who was such a skilled weaver that Athena grew jealous of her. Terrified of the goddess' wrath, Arachne hung herself from a rafter, and Athena transformed her into a spider and her rope into a web.

As spiders go, *A. cavaticus* is famous. She is the heroine of the E. B. White book *Charlotte's Web*, in which she saves the life of Wilbur the pig by writing messages in her web. So far I've not seen TERRIFIC embroidered in the garage, but for someone like Jon Coddington, the barn spider's web *does* have messages. Jon is a specialist in spider behavior and taxonomy.

Back at the beginning of time, when I took introductory biology, living things were divided into a neat hierarchical series of inter-nesting boxes, called taxa, with the higher taxa containing the lower: kingdom, phylum, class, order, family, genus, species. Of the first, kingdom, there were two: animal and vegetable, although even then bacteria were something of a problem, off to one side. The whole lot was presented in an ascending order with mankind triumphant at the top. In those days, taxonomy was mainly a matter of identifying and naming what few species remained to be discovered.

Well, the world hasn't changed, but our understanding of it has, and taxonomy is no longer so simple. The biological source book I now use lists eight kingdoms, elevating several kinds of bacteria, slime molds and other organisms to that status. Other reputable texts list as many as 30. Interlarded between all those old familiar taxa are such new ones as "superfamily" and "subgenus."

It turns out also that there are more species we don't know anything about than we ever dreamed of in introductory biology. Vertebrates, of which we are one kind, are big and obvious and fairly well known, but better sampling techniques are finding millions of new invertebrates from the treetops to the ocean bottoms.

Taxonomists of Jon's sort ask questions about what is going on at the higher taxonomic levels: What constitutes spiderishness? How does one family of spiders differ from another? What is the evolutionary relationship of taxa of spiders that spin different kinds of webs? Asking questions like these was the way Jon overturned a long-held notion about spider phylogeny, or evolutionary history.

Spiders spin a variety of webs peculiar to their own kind. Sheet-web spiders, for instance, make webs that look like flattened hammocks. Theridiid spiders are the ones that spin those cobwebs that tidy people dust out of basement corners. My *A. cavaticus* and others spin the familiar orb-shaped webs.

It had long been assumed that orb webs were the highest achievement of spiderly craft and were, adaptively speaking, the most advanced. Such webs were thought to be maximally efficient, which is why their production had evolved independently in different taxa

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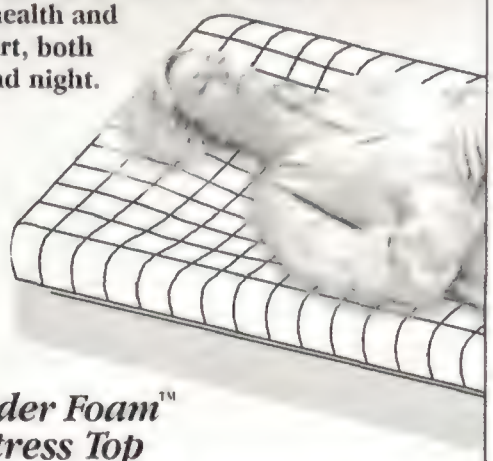

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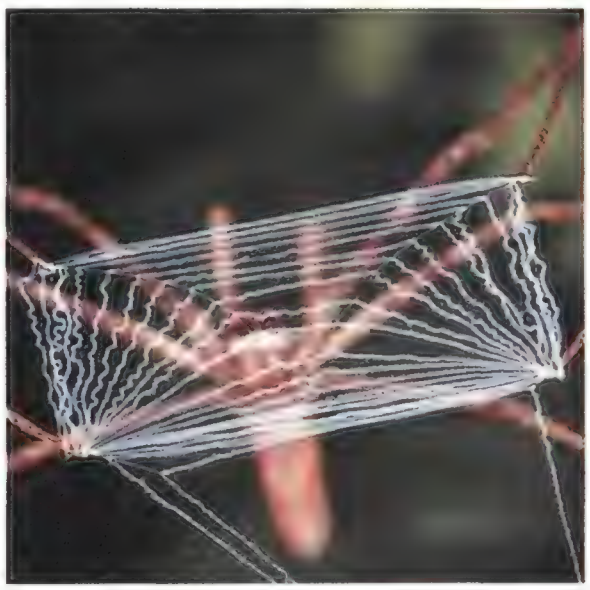

Familiar orb web, top left, is made by the barn spider. Funnel-web spider, top right, perches on its handiwork. Rectangular grid, bottom left, is made by the Australian net-casting spider. At lower right is web of cobweb spinner.

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of spiders. They were certainly worthy of the sort of spider who could lay out SOME PIG in her web.

After careful observation, however, Jon inferred that rather than being the ultimate web, the orb web is primitive, ancestral. The cobweb is actually much denser, more protective and more efficient for trapping prey than the orb web, and more elaborately engineered, as well. He concluded that the cobweb evolved from the orb web, rather than vice versa. The earlier spider classifications that separated orb weavers into differing taxa based on anatomical differences have been generally scrapped, Jon tells me, because consolidating all orb weavers in a single line is a much better representation of what we know about their behavior.

I am sitting in his office on the third floor of the Natural History museum as he explains this to me. The sun floods through his windows overlooking the Mall beyond. Jon is a tall, lanky, rumple-haired young man. He is dressed in an open-necked shirt, khakis and Birkenstocks. Every year more than five million people visit the museum. They remember the elephant in the rotunda, the nice lady at the information booth or dinnertime for the tarantula in the Insect Zoo. But what they do not see is the undisplayed 99 percent of the collections, numbering 122 million objects, or the 400 scientists and technicians who work with them. To be precise, there are 108 Smithsonian scientists and another 25 to 30 scientists from federal agencies whose research duties keep them in the museum full time. Together, the scientists, support staff and collections make up the largest research museum

in the nation and one of the preeminent in the world.

Jon's sunny office is filled with books, files of arachnological papers and a scattering of vials containing spiders afloat in alcohol. He shows me a flat container with a real web in it—that of a brown recluse spider, whose bite is as dreaded by many people as that of a black widow. "Good taxonomy," says Jon, "has predictive value, which is often useful. For instance, there is a spider in South Africa known as *Sicarius*—the name means 'murderer'—that can give a serious bite. No one has done much work on it, but we do know it is in the family Sicariidae, which is, taxonomically, the sister group of the family Loxoscelidae, the family to which the brown recluse belongs. We *do* know rather a lot about the brown recluse, so we can make predictions about the biology of *Sicarius* and know how to treat the bites."

Bad taxonomy, on the other hand, can be expensive. Many millions of dollars have been spent to eradicate the gypsy moth in this country; it was imported from Europe a little more than one hundred years ago as a consequence of mistaken taxonomy. Leopold Trouvelot, a French amateur naturalist and astronomer, was using the gypsy moth in an attempt to develop a better silkworm when it escaped from his laboratory near Boston. Undeterred by natural predators, it has been eating its way through our Eastern forests ever since. In Trouvelot's time, the gypsy moth was classified in the genus *Bombyx*, that of the silkworm, which was and still is *Bombyx mori*. The gypsy moth was, but no longer is, *Bombyx dispar* (meaning a silkworm with males and females of different color). Trouvelot probably would not have experimented with it had he known it by today's name, *Lymantria dispar*. Lymantria means "destroyer."

On Jon's desk are specimen spiders that have been collected in the

Sue Hubbell has written recently about square dancing, tabloids and the annual Fourth of July butterfly count.

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Cameroons. Jon tries to spend about a third of his time in the field collecting spiders and studying their behavior. He passes the spiders, along with the exact location where they were collected, to a colleague who enters information about them into the computer record and prints out labels that identify them and tell the who, when and where of their collection. Groups of individual vials containing the new specimens are packed into straight-sided, half-liter, alcohol-filled bottles that resemble old-fashioned home-canning jars because they are closed with a rubber gasket and a metal clamp.

Jon takes me back to a room filled with tan metal cabinets that look like map cases with fat drawers. Within the drawers the half-liter jars are stored, arranged alphabetically by family and subarranged by genus and species, if known, and geographical origin. He pulls out a drawer containing my *A. cavaticus*. There are two vial-filled jars of them, but many more of other species of *Araneus*. All told, Jon estimates, the museum's spider collection contains some 116,000 specimens.

The museum's entire entomological collection, which includes not only spiders but insects and myriapods (the millipedes and centipedes), contains

Jon Coddington holds tarantula from the Insect Zoo at Natural History.

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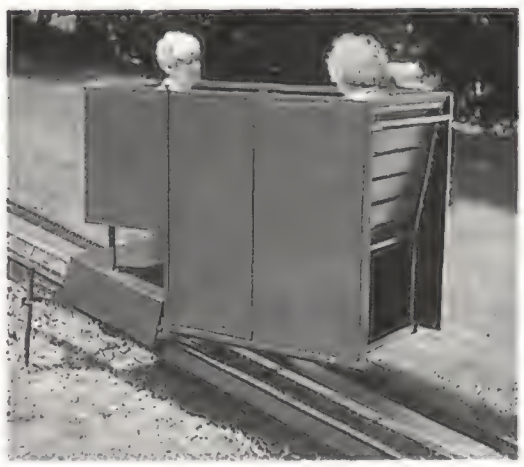

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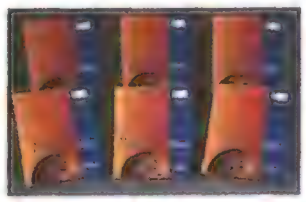

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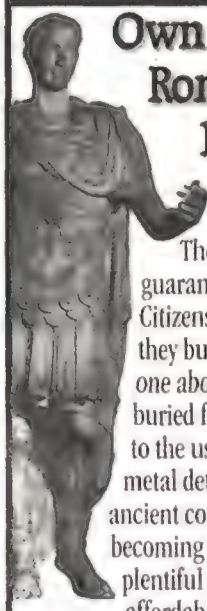

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almost 300 times that number, or 31 million specimens. "It is," Jon tells me, "one of the most inclusive and accessible entomological collections in existence. The only other of equal importance is the one at the British Museum."

Specimens, preserved and classified, make up what is called a "synoptic" collection. That means that it is a synopsis, a holding of representatives of major taxa from all over the world. "This collection," says Jon, "contains one of the greatest synoptic collections of insects and their relatives on Earth. This is where diversity can be studied."

Each year some 9,000 scholars visit the museum to use its collections. One famous researcher who made that sort of a visit was Hirohito, better known as a divine emperor than as a marine biologist. When he came to Washington on a state visit in 1975, he was keen to examine the museum's coelenterates, a sampling of the hydra, jellyfish, sea anemones and corals of the world, to identify some of the species in his own collection. So keen was he, in fact, that once he began work, he overstayed the brief time his State Department handlers had allotted and, to their dismay, refused to leave until he was done. "This may be one of the few times that protocol has given way to natural history," according to Ellis Yochelson, the museum's historian.

These collections, then, are the heart of the museum. Anna K. Behrensmeyer, the acting associate director for science, points out: "We must have the objects themselves to serve as the factual basis for knowledge, the final arbiter in matters of contested identity or meaning, the 'ground truth' that underlies our understanding of the world we inhabit."

Researchers can borrow from the museum. Last year more than 140,000 specimens from the entomological collections were sent out on loan. "Let's say someone is trying to figure out if they've found a new species," Jon says. "He has two females, slightly different, and no males. Are they one species or two? He needs a much larger series—that is, a number of specimens reflecting the range of variation within the taxon—to make the decision, so he borrows what we have." A loan is normally made for 2 years but can be renewed, and sometimes specimens are kept for 10 or even 15 years by qualified researchers.

Facilitating this kind of scientific scholarship is one of the Smithsonian's main reasons for being. The act of Congress that created the Institution in 1846 specified that it should collect, classify and arrange "objects of natural history." Today the Natural History museum is one of the largest and most important centers of classificatory biology in the world.

We humans have the sorts of brains that cannot handle nature raw. We have to arrange all of the bits and

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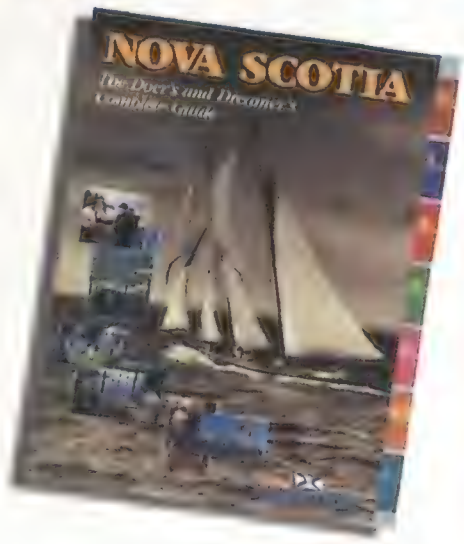

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Popularized as "Charlotte" by writer E. B. White, a barn spider sits on web.

pieces into piles, and if there are too many piles, we arrange *those* into clusters. Without ordering systems, which is what taxonomies are, we can't think, communicate, live or work. We would find it hard to make our way through our shopping list at the grocery store if we didn't have in our head mental categories. Without, for instance, the category "orange," we would have to remember each time we shopped that we wanted those orange things with sweet, juicy orange stuff inside and not the yellow things with tart juice inside. What's more, we want the oranges and lemons grouped together, in a citrus row. And, please, put all fruits and vegetables in one big section called Produce, not mixed in with the coffee and kitty litter. That's taxonomy.

From Aristotle to Foucault, the world's heavy (and sometimes not so heavy) thinkers have seized upon taxonomy as an intellectual joy as well as a practical exercise. It is so much fun to create neat systems! Early taxonomists generally selected single characteristics with which to divide up the living world. Aristotle used blooded and bloodless to make the first division, and subdivided by other characteristics, such as hairiness or hairlessness. Linnaeus, who invented the system of

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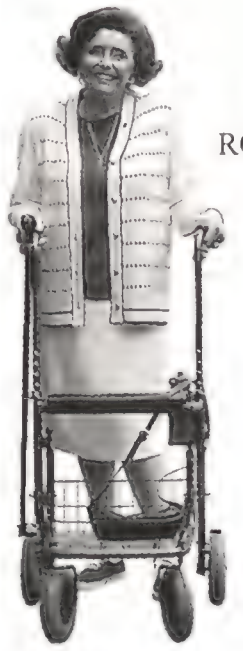

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binomial Latin scientific names, divided up all the insects by their wing styles. And we still use many of his names for the insect orders: butterflies and moths, for instance, go by the Linnaean name of Lepidoptera, those beings with scaly wings. Fabricius, a sometime pupil of Linnaeus, thought jaws were all, and a relict of his classification lives on in our current name for the order to which dragonflies belong: Odonata, the "tooth-jawed." These single-character ordering schemes, known as keys, are like a game of Twenty Questions. When applied to trees, for example, a key might ask: Stems—fuzzy or smooth? Leaves—opposite or alternating? And so on until an identification is made.

Other thinkers had other ways of looking at the world, however. The 18th-century French naturalist Michel Adanson believed that those single-character ordering systems were "artificial," and he developed a Universal System that made use of all known characters. He believed such a system was more "natural," but in his time his system was considered too unwieldy, and Adanson was thought to be an eccentric. He sounds like a sweet man; toward the end of his life he requested that his grave be marked with a garland of flowers from the 58 plant families he had elucidated.

Others looked for a natural system; they believed that life's mystical unity would be revealed if only the presumed relationships and affinities between all the bits of it could be arranged in the proper configuration. One of these was the Great Chain of Being, a ladder-like arrangement with lowly plants and animals at the bottom and humans on the very top rung. Then there were the Quinarians, who held that all life could be divided into systems of five: five circles arranged in a greater circle. Affinities were found where the circles touched, or "osculated." Each circle could be subdivided into additional fives, such as a circle of five-pointed stars of the family of crows and ravens.

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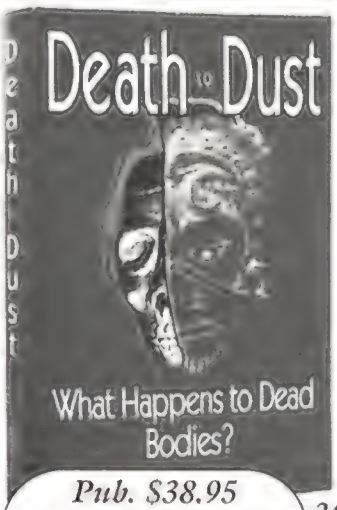

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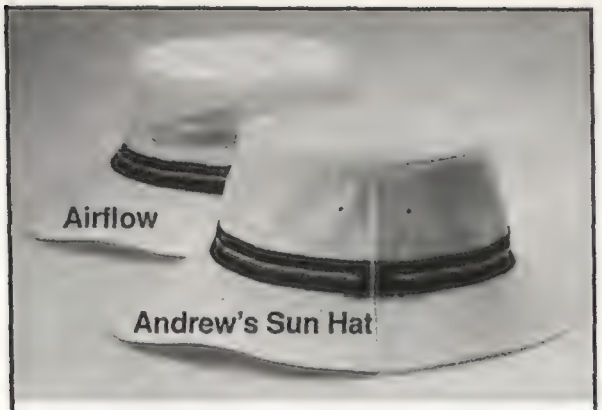

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No one until the age of Darwin considered organisms except as they existed, fixed in form and time. The most empirical classifiers examined body parts, measured genitalia, compared color, speculated on the function of organs of the dead specimens to hand. Darwin's evolutionary thinking forever changed taxonomy by introducing a principle of history into natural history. The additional dimension of history was eventually to revolutionize taxonomy for a couple of reasons. First, it was real: all organic diversity arose through evolution, and evolution is "descent with modification." Second, the history of an organism is unique, singular: organisms have only one history. There is only one true evolutionary tree.

Japanese emperor Hirohito studies marine specimens at Natural History.

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This was by no means an instant revolution, however. Darwin's influence on religion and science was profound, but his ideas had little immediate effect on classification. Taxonomists stayed with the systems they had built and did not rush to change them to one based on evolution rather than appearance. It was not until the 1960s, in fact, that evolutionary, or phylogenetic, classification came into its own. The system that eventually emerged is known as cladistics, and while not accepted 100 percent by taxonomists, it is now in use at major museums and universities throughout the world.

Cladistics is a "laser-like effort" to find the one true tree, Jon says. It defines a given taxon by making use of unique traits, believed to be of such recent evolutionary origin that they set the members of that taxon apart from any other taxa on the family tree. These traits are drawn from summaries of everything known about the animals within the taxon: their biology, behavior, molecular profiles, biochemistry, and fossil history if known. When the animals defined by specific traits are grouped, therefore, it is assumed that they diverged from a common ancestor and are closely related.

"Cladistics," Jon says, "is the quantitative analysis of comparative data used to reconstruct evolutionary trees. It took numerical analysis and wedded it to our biological understanding of evolutionary history. It is also simply the most efficient way that has yet been devised to store and retrieve biological information."

On a simple level, here's how it works. Let's say that when you are studying the order of spider, "eight-leggishness" would not be considered a "derived" trait because all of the class Arachnida—ticks, daddy longlegs and mites, as well as spiders—have eight legs. For this purpose, it is a primitive trait that emerged early in the evolutionary history of the class. You would define spiders as an order by other, more recent characteristics, two of which might be "having silk-spinning organs at the nether end of the body" and "having fangs equipped with poison glands." For cladistic analysis *within* the order of spiders, those two traits would become primitive because all spiders possess them, and other characteristics would be looked for to sort out families, genera and species.

In whimsical sketch, Charles Darwin holds an evolutionary "tree of life."

I asked Jon to give me an example of what separated a cobweb spider from my barn spider, *A. cavaticus*. He told me that cobweb spiders (and a few of their relatives) hurl huge droplets of sticky silk to attack their prey. *A. cavaticus* can only hang sticky silk in its webs. The sticky-silk attack is always the same in cobweb weavers. It is unique. It is a derived trait.

Jon pulls from under a pile of papers a computer printout that he calls, proudly, "*the* matrix," which contains 49,000 observations of spiders accumulated to date by him and his colleagues. It applies 354 traits or charac-

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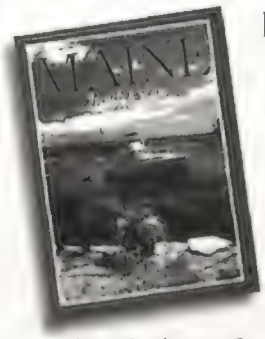

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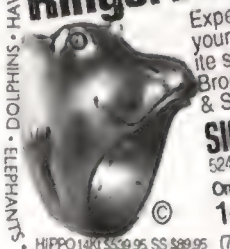

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teristics along one axis to 139 genera of spiders along the other axis. Points in the matrix include spiders' body structure, behavior, biochemical makeup, web-building patterns—anything that can be found in the literature. These 49,000 observations are coded digitally so that comparisons may be sorted out by computer. The family trees worked out from these comparisons, called cladograms, are visual representations of this analysis. Having them enables us to make major predictions about newly discovered organisms, especially "exotics," those that have arrived from elsewhere. The cladograms tell us instantly what other organisms share the same behavior. In agriculture and disease control, such knowledge can be worth billions.

The origins of cladistic analysis lie in the work of a little-known German entomologist, Willi Hennig, who died in 1976. Hennig wanted to create a taxonomic system that emphasized phylogeny (the evolutionary history of a genetically related group of organisms) in groupings by using recent characteristics instead of older ones.

During World War II, Hennig was held prisoner by the British in Italy. While he was there he wrote a book in which he sketched a "phylogenetic systematics" that, he hoped, would prove to be nothing less than "the general reference system of biology."

The book was largely unnoticed until the late 1960s, when a revised edition was translated into English as *Phylogenetic Systematics*. A group from the American Museum of Natural History adapted the computer techniques of the numerical taxonomists to Hennig's ideas. Numerical taxonomy is a kind of computer systematics that uses all of an animal's characteristics to create an "objective, repeatable classification scheme."

As taxonomists continue to identify more and more new species and revise ever upward their estimates about how many others remain to be discovered, taxonomy itself has come increasingly to resemble a numbers game. In Cod-

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dington's specialty alone, there are today something better than 36,000 known species of spiders and perhaps another 100,000 as yet unknown.

"Look," Jon says, "there are only 7,000 families of all kinds of life on this planet. Of those 7,000 families, there are 105 that are spiders. We have, right here in the museum, representatives of nearly all of them." Taking it to the next level, he tells me there are 3,000 genera of spiders of which the museum has about 600 named and identified (many more are waiting in those jars). He is working fast to collect the rest of them before they are extinguished, to fill out the synopsis the world's museums hold. Jon is an engaging man who wears his erudition lightly. He smiles easily, but when he speaks of this aspect of his work as curator, he is intense, serious.

"You know what I want to do?" Jon continues. "I want to create, as quickly as possible, a synoptic collection of the chunk of life for which I am responsible. Because 200 years from now there's going to be a news conference held here, right in the museum. There will be the Minister of Environmental Affairs, who will announce that the inventory of life on Earth is complete: 5,748,941 species. And some reporter will stand up and ask, 'But Madame Minister, didn't they say 200 years ago that there were 12 million, 15 million, 30 million, even 80 million species?'

"Madame Minister will be able to answer in only one of two ways. Either she'll say, 'Well, we lunched them all,' or she'll say, 'They didn't know what they were doing 200 years ago.' I want to make it impossible for her to give that last answer."

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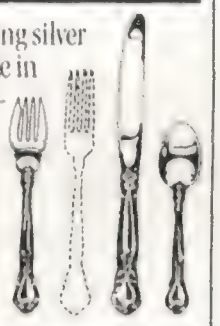

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paper $29.95) Twenty-three accomplished figures, among them artisans and tribal leaders, reflect on objects from the museum's collections and celebrate their own culture and traditions. 1

The Smithsonian Guides to Natural America (Smithsonian Books/Random House, $16.95 each) In search of bluebells, box turtles or more: this informative series will light the way for travelers journeying from national parks to unknown backroads sanctuaries. 2

The Real McCoy: African-American Invention and Innovation, 1619-1930 by Portia P. James (SI Press/Anacostia Museum, $19.95) This chronicle restores to history the monumental contributions of men and women who, facing down oppression, advanced America's technological revolution. 1

An Ocean Apart: Contemporary Vietnamese Art from the United States and Vietnam (Smithsonian Institution Traveling Exhibition Service [SITES]/Roberts Rinehart, $22.95) Bridging two cultures, a groundbreaking catalog introduces painters, sculptors, mixed-media artists from Vietnam and the expatriate community in the United States. 5

African Nomadic Architecture by Labelle Prussin (SI Press/National Museum of African Art, $55) Transporting readers from West Africa to the Horn, the author has created an excursion into desert cultures and a vivid testament to the beautiful, ingenious structures created largely by nomadic women. 1

Hirshhorn Museum and Sculpture Garden: 150 Works of Art (Hirshhorn/Abrams) A connoisseur's delight: Rodin to Warhol and beyond, this volume offers the next best thing to an afternoon's stroll inside the museum's galleries. Note: not available until November 1996.

Recordings

Louis Armstrong: Portrait of the Artist as a Young Man, 1923-34 (SI Press, American Jazz Heritage/Columbia/Legacy/Sony, 4 CDs $59.96; 4 cassettes $49.96) The Grammy Award-winning collection, featuring 81 hits from "Ain't Misbehavin'" to "West End Blues." 2

Creation's Journey: Native American Music (Smithsonian/Folkways/National Museum of the American Indian, CD $14.98; cassette $9.98) Ranging from Blackfoot to Zapotec, this selection encompasses social and ceremonial dances, oral histories, personal stories. 6

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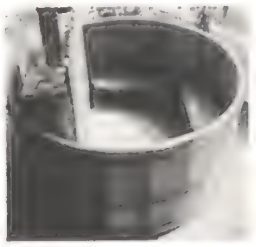

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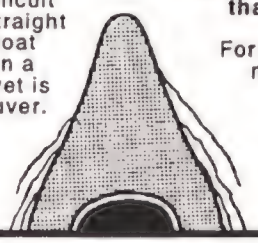

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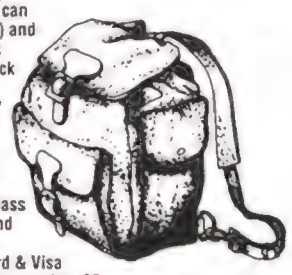

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The Victory Collection: The Smithsonian Remembers When America Went to War (SI Press/RCA/BMG, 3 CDs $29.95; 3 cassettes $25.95) Forty-five classic recordings, "Rum and Coca-Cola" to "V-Day Stomp" (most unavailable since their initial release in the 1940s), accompanied by an audio documentary. 2

Folk Masters: Great performances recorded live at The Barns of Wolf Trap (Smithsonian/Folkways, CD $14.98; cassette $9.98) Cajun to Bluegrass, rockabilly to Klezmer and Gospel, the evolving sounds of American music. 6

Beyond Category: The Musical Genius of Duke Ellington (SI Press, American Jazz Heritage/RCA/BMG, 2 CDs $19.97; 2 cassettes $17.97) Thirty-seven of Ellington's greatest recordings from the late 1920s to the '70s. 2

The Smithsonian Collection of Classic Jazz (Smithsonian Collection of Recordings/Columbia/Sony, 5 CDs $59.96; 5 cassettes $49.96) Seven decades, 95 selections, from Scott Joplin's "Maple Leaf Rag" to the World Saxophone Quartet's "Steppin'," the definitive jazz compendium. 2

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Dreams of Flight II (Air & Space/ SMITHSONIAN magazine with SunWest Media Group, 2 cassettes $44.95) Jules Verne's fantastical visions, Apollo 13's hazardous return to Earth, today's dreamers who want to colonize the Moon—space adventures imaginary and real, unfold in a riveting videocassette collection, *To the Moon* and *Beyond the Moon*. 2

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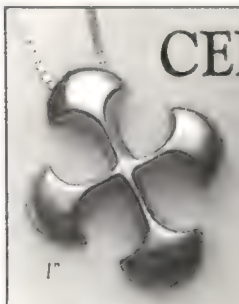

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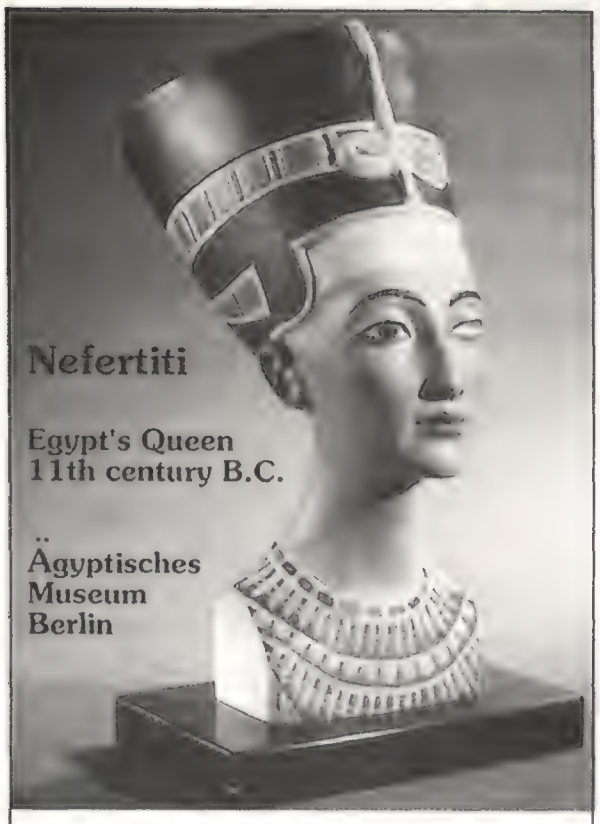

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the-scenes journey into the lives of animals, and the humans who care for them, at the National Zoo. 2

Dream Window: Reflections on the Japanese Garden (Smithsonian Office of Telecommunications with Kajima, Tokyo, VHS $29.95, laserdisk $34.95) Serene realm of stone and greenery, bridge and ornamental pool, these gardens beckon as islands of tranquillity: includes Sogetsu Hall and the legendary Moss Temple of Saiho-ji. 8

Dinosaurs (SI Press, $17.95) The lost and brooding world of triceratops and tyrannosaurus revealed against a backdrop of startling new discoveries, including breakthrough contributions by Smithsonian scientists. 2

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In Open Air: A Portrait of the American Impressionists (Smithsonian Office of Telecommunications, $19.95) As the 19th century waned, a group of painters, among them Childe Hassam and William Merritt Chase, sought to record the transient beauties of a fast-disappearing American landscape. 8

Inside Hawaiian Volcanoes (SI Press, $9.95) The tempest that rages under the islands' surface: live-action footage of major eruptions, accompanied by an overview of the most recent developments in volcanology research. 2

Educational Resources

Resources for Teaching Elementary School Science (National Academy Press, $17.95) From the National Science Resources Center (NSRC), sponsored by the National Academy of Sciences and the Smithsonian Institution, this landmark volume is a comprehensive guide to hands-on, inquiry-based science curriculum materials and other resources for teaching kindergarten through sixth grade—a book intended to help revolutionize the teaching of science. The NSRC also has produced Science and Technology for Children, a series of hands-on science curriculum units for grades one through six. 9

Cultural Reporter by Lisa Falk, with contributing authors (Smithsonian Institution/National Museum of American History/Tom Snyder Productions, classroom kit $179.95) For high school students, a curriculum kit designed to engage young people in documenting their communities and their local history. This interdisciplinary project directs students to draw on skills as writers, historians, photographers, reporters and filmmakers. Includes software. 10

Minds-On Science (Smithsonian Institution National Museum of American History/Tom Snyder Productions, each kit $249.95, optional software $49.95 each, packages of three kits $599.95, optional software $129.95) Step into the shoes of a scientist and confront issues that emerge when science meets society: a laserdisk series and curriculum package for middle-school students. This pioneering series contains three titles: *For the Sake of the Nation* (students are asked to assume the role of Science Adviser to the President); *The Impact of Discovery* (students take on the identity of a scientist who has discovered a compound that improves memory); *For Profit, For Planet* (as the CEO of Future Look Fashions, students investigate technological change and issues of corporate ethics). 10

Art to Zoo (Smithsonian Office of Elementary and Secondary Education; Free) A quarterly publication for grades four through nine that draws on the Institution's exhibitions and programs to create classroom-ready materials. Includes lesson plans, worksheets, take-home pages for photocopying; each issue devoted to a particular topic. 11

Beyond the Frame: Using Art as a Basis for Interdisciplinary Learning (Smithsonian Office of Elementary and Secondary Education, $5) Based on pieces in Smithsonian collections, an introduction to art history and a window on esthetics, social history, geography, cultural anthropology and more. 11

The RIF Guide to Encouraging Young Readers, edited by Ruth Graves (Doubleday, $10) From Reading Is Fundamental, the children's literacy organization associated with the Smithsonian, a trove of advice and activities, and an annotated list of books and resources. 12

Kathleen Burke

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Additional Sources

Around the Mall (p. 30)
Muzzle Blasts (magazine), National Muzzle Loading Rifle Association (Friendship, Indiana)

Object at Hand (p. 34)
The Smithsonian: 150 Years of Adventure, Discovery, and Wonder by James Conaway, Smithsonian Books/Knopf, 1995

'America's Smithsonian' (p. 48)
America's Smithsonian: Celebrating 150 Years, Smithsonian Institution Press, 1996
150 Years of America's Smithsonian: Discovering, Imagining, Remembering (CD-ROM), Macmillan Digital USA, 1996

Suyá Indians (p. 62)
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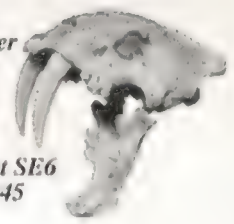

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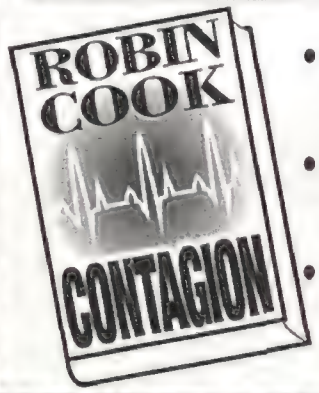

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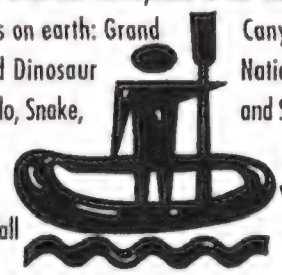

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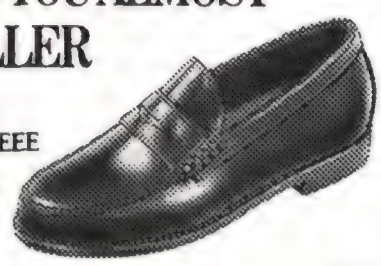

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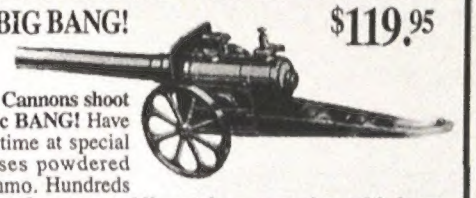

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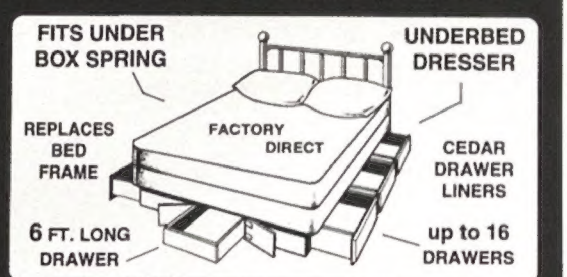

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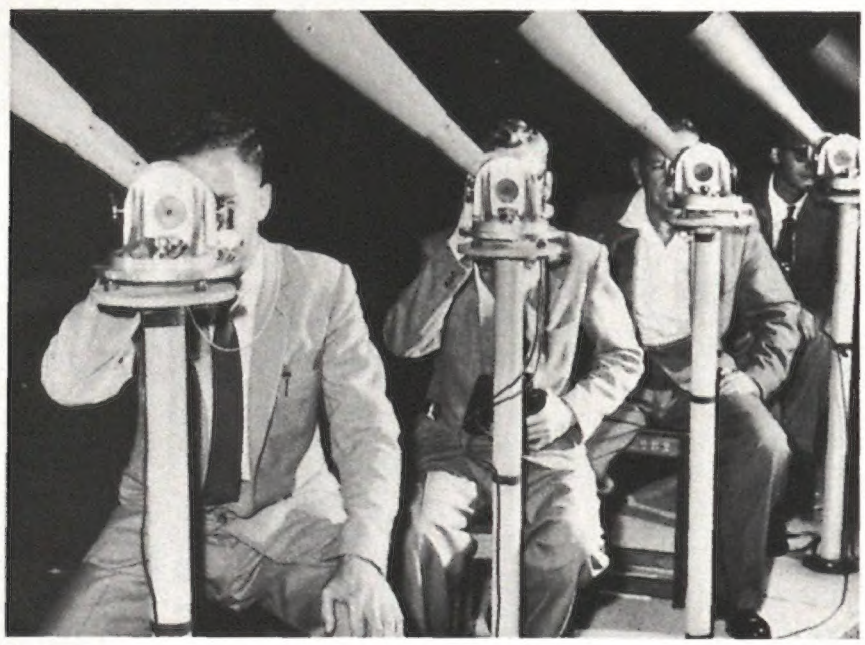

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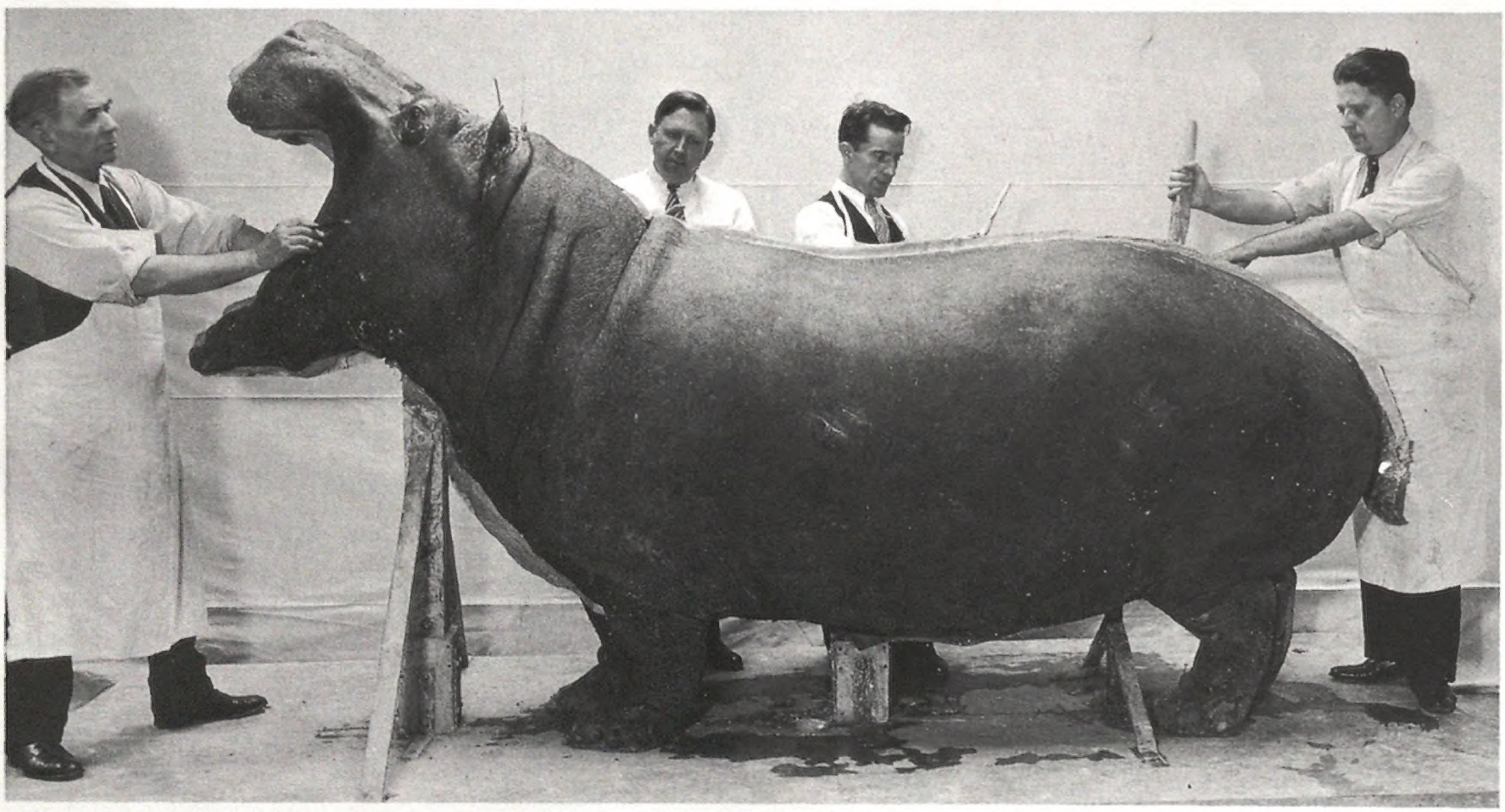

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